The Electrical World.

VOL. XXXII. NEW YORK, NOVEMBER 5, 1898. No. 19.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

In the United States, Canada or Mexico; other foreign countries, $6.00.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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ELECTRIC AUTOMOBILES.

It is becoming more and more apparent that the electric automobile industry is in a stage comparable with that of electric traction about ten years ago—namely, just on the threshold of a tremendous expansion. The problems arising in the development of this class of apparatus are apparently as discouraging as those of electric traction were at the time mentioned, but means of overcoming them are being gradually developed in many a shop, factory and experimental laboratory, with results that are oftentimes astonishing.

The developments in this line in France and America are quite readily compared by the illustrated descriptions of the vehicles of both countries in other columns of this paper. The competition held last summer in Paris in connection with the Tuileries exhibition brought forth a large number of electric vehicles, the study of which allows a few general comparisons of French and American practice to be drawn. In general the French vehicles appear to be more crude, more experimental, more primitive and more complicated than those of American design, albeit one cannot help admiring the ingenious mechanisms embodied in many of them to overcome self-imposed difficulties. Sprocket chains are almost invariably used by the Frenchman, apparently because hydro-carbon automobiles were developed in advance of the electric, and the oil engines were necessarily placed in the body to avoid the difficulties of flexible piping. Imitating these, the makers of electric carriages have put the motors in the body, while in America street railway practice has been followed and either a rigid or the so-called "wheel barrow" or Sprague suspension, with spur gears, has been followed. The French also, regardless of the liability of breakdown, have added complication after complication to get small refinements far in advance of the time. Such are, for example, nine speeds forward and about as many backward, electric brakes utilizing the motor as a generator on dead resistance, battery recuperation on down grades, etc., etc., while Americans have aimed for simplicity and effectiveness. The French, on the other hand, use almost entirely plain axles, while Americans as exclusively use those of the ball or roller bearing types.

The problems involved in the development of this branch of electrical engineering differ radically from those of any others, resembling only in a small degree those of rail traction. The worst problem is, of course, the storage battery, which will spatter, fume, give out on the road, leak, buckle, disintegrate, corrode, short circuit and do many other undesirable things under the severe conditions of automobile work in spite of all its recent improvements. As has been concisely said of it in a remark credited to Mr. T. A. Edison, "The ——— thing is wet."

Among the mechanical problems are, first, those of the gearing. The simplest arrangement and that generally first tried by inexperienced designers is the meshing of the motor shaft with a gear directly on the wheel spokes. This is quickly abandoned, owing to the impossibility of keeping such a gear true or of enclosing it. Ball-bearing hubs are anything but accurate in alignment and axle-driven wheels are by many preferred to hub-driven. In rounding corners, one of the driving wheels must turn much faster than the other, and the wheels cannot therefore be rigidly coupled together. To give the same torque to each with this difference of speed a dif-

ferential or compensating gear, known in the shops as a "Jack-in-the-box" and commonly of the epicyclic-bevel-train type, is used. This, of course, is not necessary if the vehicle is of such a size that two motors, each independently connected to its own driving wheel, can be economically used. The connection of the two armatures in series gives any desired variation of the relative speed with the same torque on both.

In steering the common fifth wheel or centre-pivot of the forward axle-tree gives altogether too great blows and jerks to the steering handle when either wheel meets obstructions. The axle-tree is therefore commonly fixed, and the wheels turn each about its own pivot near the hub. Sometimes these pivots are vertical, and within the hub itself, at other times just offset toward the centre of the carriage and either vertical or inclined somewhat. The operation of steering is, even with this improvement, more or less tiresome, and worm gears, oil cylinder locks and other devices are often used to prevent the wheels being deflected by variations in the roadway. One maker inclines his pivots in such a way as to give the wheels a tendency to always return to a straight-ahead direction. An interesting geometrical problem in this connection is the difficulty of getting the proper relative angular deviation of the two steering wheels. If in turning they both swing through the same angle the four wheels of the carriage will not be tangent to concentric circles, as is necessary for the proper riding in a curved path. The inner wheel must be swung through an angle greater than the outer. This is commonly approximated by making the pivot cranks non-parallel.

The speed control is commonly effected in American practice by dividing the batteries into four groups which may be placed all in multiple, two in multiple and two in series, or all four in series, thus giving three voltages and three speeds, others being sometimes added by commutation or rearrangement of the field coils, dead resistances rarely being used. The French, however, favor keeping the batteries always in series, so that all the cells of one vehicle invariably receive the same discharge, as they do the same charge, and obtain their speed control by all sorts of devices, such as double commutators, changeable gears, etc., etc. The loads carried in this work are so small that magnetic or other blowouts are not necessary in the controllers which break the current satisfactorily with the quick motion obtained by cam notches.

As between the electric and the hydro-carbon-propelled automobile, the former has the advantages of quieter running, easier control, greater simplicity, less apparent danger, absence of odor, heat and vibration, which appeal powerfully to the layman and the purchaser of such vehicles. For long runs without replenishing—that is, for cross-country service similar to that of the stage coach—the hydro-carbon vehicles are undoubtedly superior, but for city service the advantages of electric propulsion are overwhelming.

BOUNDLESS SPACE A BUS BAR.

One of the American electrical journals has recently taken some of Mr. Nikola Tesla's patents undoubtedly more seriously than the inventor himself intended them, and advanced the ideas there tentatively proposed as a revolutionary invention comparable with those of the same inventor in the rotary-field line, and has, with the aid of the gullible daily press, given the public in general another false impression of the wonders of electricity. The idea proposed comprises nothing more nor less than a high-tension step-up transformer feeding into a vertical conductor with a terminal at such an elevation above the earth as to reach a strata of rarefied atmosphere which has a comparatively low electrical resistance, a similar step-down transformer to be connected at any desired point with the same conducting strata by means of any suitable device, such as that used by the illustrious Benjamin Franklin, or, preferably, as stated in the patent, by means of a balloon, the earth being utilized as a ground return.

The fact is set forth that the atmosphere at 15 pounds to the square inch, or other pressures common near the surface of this mundane sphere, is a good insulator, while at lower pressures, as is well known by manufacturers of 200-volt lamps, it becomes quite a fair conductor. By a rigid suppression of the reasoning faculties and a little freedom of the imagination, fancy pictures a conductor poked up through the insulating sheath at Niagara, establishing an alternating difference of potential between the superincumbent ether and this ball of solid matter below protected by an atmospheric dielectric, which difference of potential can be tapped, so to speak, at any desired location, such as the large cities, or by express trains with electric locomotives towing balloon trolleys, making contact with an overhead conductor from which they cannot readily slip off. The use of several great sources of natural power will, of course, necessitate generators of the same frequency running in synchronism with each other, as they are all, so to speak, connected across the same bus bars, and lacking the third bus bar, multiphase systems will go out of fashion.

The system might, however, give other results more valuable than those of power transmission. With transmitting and receiving stations at Niagara Falls and New York city, respectively, the State of New York would possibly be illuminated by a gigantic Geissler tube overhead that would turn night into day, put to shame the aurora borealis, and make the advocates of diffused illumination shout for joy.*

Mr. Tesla should certainly be enjoined from putting his polished ball terminals too high, or a Crookes-tube effect might be obtained, emitting a profusion of X-rays which would disclose altogether too much to anyone with fluorescent spectacles, and might make it necessary for mortals to carry leaden umbrellas to prevent the skin being burned from the tops of their heads.

The patent gives no data as to the estimated height to which it would be necessary to elevate the terminals. It is obvious that a height sufficient for a very marked difference in the specific resistance must be attained, otherwise the voltage would be necessarily so high that fatal leakage through the extended sheet of insulating medium would ensue. No such marked change of resistance occurs at the highest elevations yet attained by man, several miles upward, and the atmospheric pressure falls off somewhat more slowly even than by a logarithmic law, so that scores or hundreds of miles of elevation would be necessary. The methods of ballooning at this elevation and supporting conductors of this length are not explained in the patent.

With a circuit looped about so many square miles of space, it is not explained how the self-inductive choking of the comparatively high-frequency currents proposed (about 1000 cycles per second) could be eliminated, and no explanation is made of the precautions to be taken against lightning. The advocates of that light-weight material, aluminum, for current-conducting purposes must take a back seat, as the ether has a lower specific gravity than anything hitherto proposed for this service. Mr. Tesla, if correctly reported, previously proposed to wabble the earth's charge for man's ignoble uses, but he now, if these things can be taken seriously, has designs on the universe. The price of copper remains in the neighborhood of 11 cents, however.

*The writer reserves all rights to the use of interplanetary space as a vacuum tube for lighting purposes.

X-Rays in the Army.

BY H. LYMAN SAYEN.

When the operations of the army near Santiago indicated the necessity of providing for the wounded in the United States, where better care, more healthful surroundings, and better food could be obtained than was possible in Cuba, the Government selected Fort McPherson, Ga., as one of the receiving points. Situated 4 miles southwest of Atlanta, on a tableland 1000 feet above the sea level, its pure air and water, excellent sanitary arrangements and central position in the South made it an excellent site for a general hospital for the army in the field.

Early in July I was ordered by Surgeon-General Sternberg to report for duty at the post in connection with X-ray work. Upon my arrival there I found that the finely equipped post hospital was used partly as an executive building and partly for sick and wounded officers. Immediately adjoining the hospital building is the laboratory building, one portion of which was the surgical operating room, well equipped with modern surgical appliances, while another part of the building was devoted to the biological laboratory, and it was here that the X-ray work was done.

The room was well suited to the work, and, as the water supplied to it was from an artesian well over 2000 feet deep, it offered exceptional facilities for the developing and printing. I had the shutters covered with an opaque, black oilcloth in order that the room might be made absolutely dark, even when the brightest daylight prevailed outside. It was found very essential to do this, not only for photographic purposes, but for the fact that it seems impossible to do satisfactory work in daylight. It is a matter of ten minutes or so for the eyes to accommodate themselves to the fluoroscope after being exposed to daylight, and it is impossible to keep them glued in the fluoroscope and at the same time manipulate the X-ray apparatus in a light room.

The original equipment of the X-ray laboratory contained as a generator an eight-plate static machine with plates 28 inches in diameter, running in ball bearings. The plates were in a moisture-proof case, which also contained a double-plate Wimshurst as an exciter. The main plates were driven by a large hand wheel which made one turn to four or five of the plates.

The apparatus was of excellent workmanship and, under conditions less exacting than this instance, might have performed the work required of it. While the writer's experience in the use of the static machine in connection with the generation of X-rays has been somewhat limited, a study of the conditions existing in this form of machine, together with the actual working of the apparatus at the post, leads to the conclusion that the static machine is theoretically and practically an inefficient current generator, aside from the fact that the highly humid Southern climate rarely permitted its use in this particular instance.

A static machine depends for its excitation on the potential induced at its terminals, and, as a consequence, when running at a low potential, as on a tube of low vacuum, it does not generate a sufficient quantity of current. The addition of a spark gap in series with the tube improves the output of the machine, but there is more energy lost in the spark gap than used in the tube. That is, if the machine is not running at a potential equivalent to a long spark, it will not generate enough current to properly illuminate the tube. A tube with a vacuum corresponding to a parallel spark gap of about 3 inches gives the most satisfactory results. When connected to a static machine, in order to get enough current through the tube, it is necessary to add a spark gap in series with it about 6 inches long. It will be seen from this that the machine, in order to give the proper current, generates three times the energy necessary; or, in other words, a 4-inch spark from an induction coil would do the same work, while the apparatus required would occupy but about one-twentieth of the space.

In view of the exigencies of the work Messrs. Queen & Co., Philadelphia, kindly loaned the writer a 14-inch induction coil, together with a number of their self-regulating tubes, while Dr. T. P. Hinman, of Atlanta, volunteered the use of his laboratory for the purpose of charging the batteries to run the coil, no electrical plant existing at the post.

The wounded sent to the post included those who were in the fight at El Caney, and in practically every case the X-rays were employed for diagnostic purposes. The difficulty of obtaining suitable photographic plates early in the work compelled reliance upon the findings of the fluoroscope, the location of bullets being marked by ink spots on the flesh. In the case of fractures the surgeon in charge of the patient was enabled to verify the position of the bones.

The number of wounded during the war that required the X-rays was by no means large, but the cases of injured received at Fort McPherson were of such a varied character as to fully emphasize the value of the new form of radiant energy in all field and hospital work during the war. While it is not in my province to comment on the surgical aspect of the subject I believe it to be the opinion of surgeons of experience that the older method of probing for bullets, with the consequent danger of carrying infection to the wounded parts, should be abandoned in favor of the X-rays. There is also the important factor of accuracy in the X-ray determinations, enabling the surgeon to remove the bullet through a small opening in the tissues.

All the operations of the surgeons at the post were successful in removing the bullets from the exact location, as indicated by the radiographs, and in many cases it was impossible to determine the nature of the injury except by means of the plates. The presence of some of the bullets was even unsuspected, as is shown by the case of J. R., private, Company C, Second Infantry. He was wounded at Santiago and arrived at McPherson with two pieces of lead in his arm. The presence of the larger piece was unsuspected, the smaller piece being so near the surface that recourse to the X-rays was considered unnecessary. A subsequent stiffness and soreness in the arm, however, gave rise to an X-ray examination, resulting in the successful removal of the bullet.

The present war is the first instance that our army medical department has had occasion to use X-ray apparatus to any practical extent. Apart from the novelty of the new force, there is not the opportunity in the army in time of peace to determine the value of improvements of this nature as is afforded the general hospitals.

The X-rays in the army are essentially an equipment for war, and in those times when the medical department is taxed to the utmost there is the utmost importance that they should have every facility to help in the successful treatment of the injured. Not only are the rays valuable from the standpoint of their immediate usefulness, but too much importance cannot be placed on the fact that, as records, there is nothing better or more accurate than a radiograph. In the case of J. R., should he try to obtain a pension, could there be found any better evidence of the fact that his bones are uninjured and that the possibilities of a permanent injury resulting are exceedingly small? If, together with the radiograph, there is kept an accurate history of the different cases we have an indisputable account of the effect of gunshot injuries.

It certainly seems that the recent developments in the design of X-ray apparatus have advanced it to such a state that there are great possibilities for the adaption of it to work in the field. A covered wagon, drawn by two mules, would furnish the dark room as well as the means of conveyance. It should be in charge of two men who should be so trained in the work that they would, between them, know how to take care of everything from the secondary of the induction coil to the hoofs of the mules. In the wagon might be placed a 12-inch induction coil so made that every part could be immediately removed and replaced by another, of which the wagon should contain a complete set. It should also contain, besides a complete supply of tubes and photographic apparatus, a little dynamo and windlass so the mules could put in their spare time in charging the storage batteries (although this seldom has to be done, as my experience at Fort McPherson demonstrated). A thousand pounds would cover the weight of the apparatus, and with such an equipment the wagon would be as independent as a company of infantry. The operators could bunk in their ambulance besides carrying a plentiful supply of rations.

An Automobile Exhibition in London.

An international exhibition of motor cars is to be held in London, England, next June, and it is hoped that trials and contests, with prizes and medals, will be arranged for.

Electric Automobiles in Berlin.

An electrical omnibus has lately been put into public service in Berlin, Germany, the vehicle being 23 feet in length, having a capacity of twenty-six passengers and weighing 6.65 metrical tons, of which the battery weighs 1¾ tons, and is stated to have a running capacity of thirty-seven hours.

Electrical Vehicles.*

BY JOSEPH APPLETON.

The question of electric vehicles is, to the general public, probably the most interesting among recent applications of electricity, and the field it opens up for storage batteries is almost beyond limitation. The last few years have seen the electric motor replace horses in our street cars, and those who have followed the conception and growth of the electric vehicle prophesy the same revolution in the carriages, cabs, wagons, etc., in our cities. Of course, to lovers of horseflesh this change will not appeal, for the substitution of a controller for a well-bred animal would deprive them of the principal pleasure of locomotion. There certainly can not be the same sympathy and affection between the owner and the electric motor as there is between him and an intelligent animal; but for commercial uses, where dollars and cents, and not sympathy, count, the case is different, and there are many reasons why the electric vehicle should supersede our present methods.

The cost of accomplishing by electric vehicles the work now done by horses would be probably one-half, when their adoption has become to any extent general, thus enabling the work of recharging the batteries to be organized on a proper scale.

There is an immense advantage from a sanitary point of view. Think of the hygienic measures necessary to care for the refuse of 100,000 horses, both in the stables and on the streets. This is about the number of horses in Philadelphia. Again, if the wear and tear of these 100,000 horses traveling over the streets and roads were done away with, how much simpler the problem of good roads would be. The electric vehicle possesses so many advantages over those propelled by oil or gas motors that, except for special conditions, where extremely long distances have to be covered without charging facilities, there seems to be little, if any, doubt that the former type will be the one to fill the field.

Briefly stated, the advantages of the electric vehicle over oil or gas motors are as follows:

Safety.—A storage battery will not explode, nor is it inflammable, like gasoline or kerosene.

Ease of Handling and Control.—An electric motor, with its controller, is certainly the ideal method of control, and is distinctly not in the same class with the levers and valves necessary to operate an engine.

Absence of Noise and Vibration.—Here, again, the electric motor is the ideal motor for the purpose, having a smooth rotary motion, instead of a reciprocating action, with its noise and vibration.

Absence of Heat and Smell.—An oil or gas motor must, of necessity, be accompanied by considerable heat, and usually requires a water-jacketed cylinder. From the exhaust there is an objectionable odor, due to the unconsumed gases; but with the electric motor neither of these objectionable features exists.

Cost of Operation.—There is no doubt, from independent tests made, that a vehicle can be propelled electrically with less consumption of energy than any oil or gas motor.

There are many other points which might be touched upon, but these will suffice. For city use, the question of large mileage capacity does not handicap the electric vehicle in favor of the oil or gas motor, as the supply of electricity can be renewed as desired by recharging the batteries. This part of the problem we will consider later.

The electric vehicle of to-day is the result of much arduous and expensive experimental work, and this club has the honor of containing among its members two gentlemen who have been foremost in the development of the electric vehicle in this country.

Messrs. Morris and Salom first took up the question in 1894, at which time very little had been done, either in this country or abroad, and the numerous problems of motors, gearing, wheels, tires, bearings, running gear, etc., had to be investigated and solved without the light of previous experience. The first vehicle they designed without regard to appearance, their object being to ascertain the best type for self-propulsion through all sorts of streets, considering, especially, the features of weight, size, mileage and distribution of machinery. It weighed 4250 pounds without passengers. Its mileage capacity, on one charge, was 50 to 100 miles, according to speed and grade. The battery weighed 1600 pounds. The motor was 3 horse-power nominal, but capable of developing 9 horse-power for a short period, weighing 300 pounds. The maximum speed attained was 15 miles. It was most successful, and traveled hundreds of miles without accident.

*Extracts from paper presented before the Engineers' Club of Philadelphia.

The data obtained from this proved that on good pavements a vehicle weighing, with passengers, 5000 pounds, could propel itself at a speed of 10 miles an hour, with an expenditure of energy not over 3½ horse-power, or $^{7}/_{10}$ horse-power per 1000 pounds.

These gentlemen next designed and constructed the vehicle known as the Electrobat, No. 2, which won the gold medal in the "Times-Herald" motor-cycle contest held at Chicago in November, 1895. This weighed only 1700 pounds with batteries, which was a great reduction in weight. The equipment consists of two motors, each 1½ horse-power, attached to the front axle, the pinions on the armature shaft gearing directly into the driving gears attached to the front wheels. The steering is accomplished by the hind wheels. The battery consists of forty-four cells, having a capacity of 50 ampere hours, each cell weighing 13 pounds. The controller is conveniently located at the front seat, and gives three speeds ahead and one backward, obtained by various groupings of the cells and motors. The maximum mileage on one charge was 25 miles, at 12 miles per hour; the maximum speed, 20 miles per hour. In the "Times-Herald" race this vehicle met in competition every description of motor vehicle, and the fact of its being awarded the gold medal is sufficient proof of its superiority and merit.

Messrs. Morris and Salom then proceeded to design electric vehicles for different classes of work, *e. g.*, hansom cabs, coupés and delivery wagons, etc. The next step forward was the formation of the Electric Carriage and Wagon Company, to operate vehicles in actual service in New York City.[1]

After more than a year's successful experience with these cabs it was decided to extend the scope of operation, and next month fifty more cabs and fifty broughams will be in operation in New York City in ordinary hacking service. Eventually more stables will be opened in New York City, and also in other cities.

The new vehicle is of similar design to those formerly used, but will contain certain minor improvements and additions, which experience has found to be advantageous. For example, the backward speed is obtained by a separate reversing switch, operated by the foot instead of by the controller, as it was found the driver would use the reverse position to stop his vehicle, instead of using the brake, thereby putting more strain on motor and battery.

An emergency switch is provided, which the driver operates by giving a spring a kick with the heel and releasing a little strip of copper from two contact blocks. This switch is also used if the driver wants to leave his vehicle on the street; he puts the copper link, or little strip, in his pocket and renders the vehicle inoperative. These new cabs show a marked improvement over the previous ones in the question of efficiency. At a speed of 12 miles per hour they take an average of less than 2½ horse-power, and will have about 40 miles' capacity. When going up an 8 per cent. grade, which is rarely met with in city use, they can make 6 miles an hour with 7 horse-power. This is far better than has ever been done before. The wheels are fitted with pneumatic tires of 5 inches diameter, inflated to about 120 pounds.

A vast amount of skill and care has been expended in laying out the new stables, and the arrangements for handling the vehicles and batteries are most complete.[2]

The Pope Manufacturing Company, the well-known makers of the Columbia bicycle, have taken up the manufacture of electric vehicles. Their vast manufacturing experience and exceptional facilities for making tubular frames, wire wheels and pneumatic tires render this company specially fitted for turning out the highest class of vehicles, both from an engineering and commercial standpoint. Its attention has been given to vehicles for private use, rather than public operation from a central stable.[3]

The mileage of the single-seated carriages of this make in New York City streets is about 30 miles. Over country roads, in the vicinity of Hartford, Conn., where there are many hills and roads having poor surface, a mileage of 28 miles has frequently been obtained. Over these roads the average speed, including all stops and slow-ups, is 9¾ miles per hour. The average consumption of energy, on good roads, including all zero readings when coasting, is about 1760 watts, or 2⅓ electric horse-power.

The fact that the carriages are used by the general public, and are not operated or controlled under skilled supervision, as is the case of cabs, has made it necessary to work out a system for recharging which the purchaser can carry out without trouble. Forty-four cells are used on each vehicle, so that an ordinary 110-volt

[1] See The Electrical World, August 14 and August 21, 1897.
[2] See The Electrical World, September 3, 1898.
[3] See page 483, et seq.

circuit can be used for charging. The batteries are charged in position, a suitable plug connection being provided. In each vehicle is arranged, in the battery circuit under the seat, a specially designed Thomson recording wattmeter, which, when the battery is charging, runs backward, and at a certain slower speed than when the batteries are discharging and operating the carriage. Instructions are given to continue the charging current until the wattmeter returns to the full position. This absolutely insures that a certain percentage of increase of current over what has been taken out has been put back into the batteries. The batteries are fully charged in from three to three and one-half hours. When first plugged in the current starts at 40 to 50 amperes, gradually decreasing to about 10 amperes as the counter e. m. f. of the battery builds up.

The Fischer Electric Equipment Company of Chicago is preparing to operate in that city vehicles of all descriptions. The lines it proposes to work on are to furnish the entire electrical equipment to carriage builders, using the ordinary design of carriage, with as little alteration as possible. Experience leads it to recommend two motors, thus doing away with balance-gear, and to the use of wood wheels in preference to wire wheels, and solid rubber tires in preference to pneumatic ones. It is claimed that pneumatic tires take 20 to 50 per cent. more power for the same load than solid tires, besides depreciating far more rapidly. It is proposed to do the charging with the battery in position, assuming that the public vehicles will have ample time during the day to charge from the street plug, and to adopt a prepayment system for this charging, the man putting into the switching apparatus on the charging plug a certain amount of money and getting in return a definite quantity of electrical energy.

The Riker Electric Motor Company is also building electric vehicles.[1] Some of these have been in service for some considerable time, the Victoria having made 3000 miles and the four-passenger trap 1200 miles. An electric delivery wagon is being operated by Altman & Co., in New York City.

The electric-motor vehicle must of necessity contain mechanical and electric apparatus which, in order to be maintained in proper working order and the highest state of efficiency, must have intelligent and systematic inspection. If this care and attention are given periodically, there is no doubt of the reliability and usefulness of these vehicles. It can hardly be expected that the general public will be able to give this skilled attention, and comparatively few users of such vehicles would have a mechanic in their employ who would be competent; therefore the lines upon which the business will be developed will probably be the construction of charging stations in suitable locations in the city, where the vehicles will be kept when not in use and where they will receive such attention as is necessary.

There is no doubt that the electric vehicle has come to stay. Whether future developments will lead to a different design it is impossible to say. The first railway coaches were constructed after the design of the old road coaches, but the design became modified in order to produce a vehicle which was best suited to the new method of locomotion. So it may be with the electric vehicle. The design may gradually change until we have a type of motor-vehicle entirely different from the horse-carriage.

Another Automobile Exhibition.

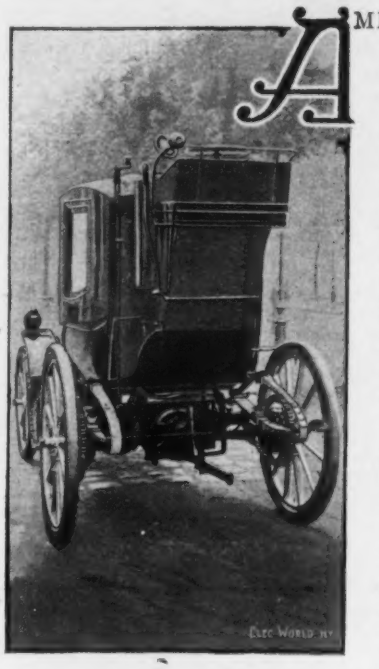
An exhibit of motor carriages was held during the last week in September at Dusseldorf, under the auspices of the Mid-European Motor-Car Club. Most of the vehicles were of the hydro-carbon motor type, although some electrical ones were shown, one being a Columbia electric carriage.

Electric Cars in London.

The Middlesex and London County Councils have at last granted permission for a line of electric cars in London, the English papers referring to it as an experimental line, though what can be the subject for experiment is hard for Americans to see. The current is to be supplied by overhead trolleys, although in a report recently presented by Mr. J. Allen Baker a most commendable statement is made that for service of this kind the open conduit is far preferable.

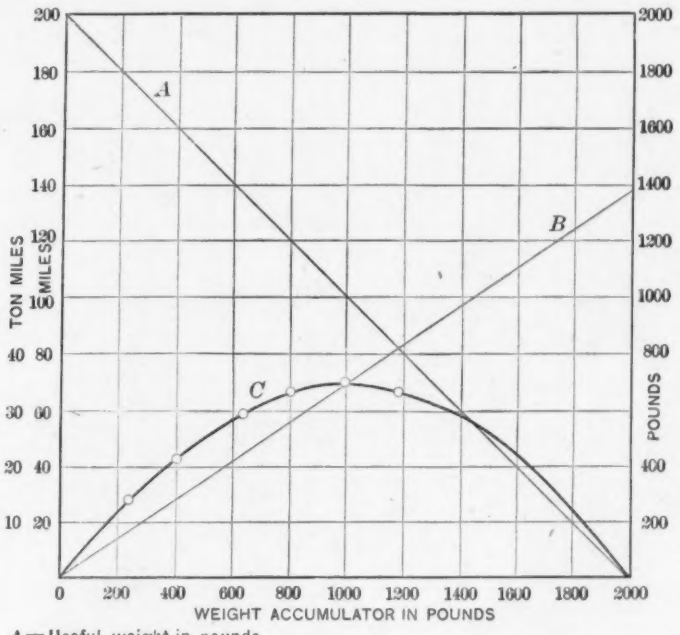
[1]See page 486, et seq.

Electric Automobiles at the Paris Concourse—I.*



AMERICANS have been accused of being a utilitarian race, utterly devoid of the æsthetic sense, and therefore caring little for the appearance of their streets, so long as these serve the purpose for which they are built. In the early days of electric lighting, plants were built everywhere with feverish haste. It mattered little how things looked if only the lights worked. The streets were filled with loose and carelessly strung wires, supported on wooden poles that looked often as if some of the bottled lightning had strayed into them by mistake, so crooked were they, and it is no uncommon thing now to see a rickety arc lamp nailed to the top of a crazy pole in some places that ought to know better. The electric railway soon added its burden to the streets; it is true that a feeble protest was heard, at first, but the protestants were soon the very people who let the horse-car go by in order to take the electric following close behind on the same track.

How does it happen, then, that the motor carriage is not with us yet? Paris, the most beautiful modern city in the world, whence the trolley-wire is banished for its unsightliness, is filled to overflowing with noisy, puffing, busy, odorous little vehicles propelling themselves about the streets. We are constantly hearing of the races which are run at break-neck speed, up hill and down dale, at imminent risk of life and limb to both participants and other unfortunates who happen to be on the road. The excitable Frenchman is unable



A — Useful weight in pounds
(Difference between total weight of outfit and weight of accumulator.)

B — Distances in miles

C — Useful work done in ton miles, equals useful weight times distance traversed.

Elec. World, N. Y.

FIG. 1.—CURVES OF ACCUMULATOR WEIGHT AND TRAVEL.

to write anything about his automobiles without first calling attention to the fact that for once he has distanced America, the home of the mechanic, on her own ground, and wonders how it has come about.

Though late in making its appearance a successful electrically

*Compiled and translated from the French technical journals.

propelled vehicle does seem to be coming to the top at last, if it is possible to prophesy anything from the results of the recent competition trial held in connection with the Tuileries exhibiton. The object of this competition was to develop a carriage which would be suitable for displacing the hacks and cabs drawn by horses now plying in Paris. The reward of success being a very substantial one in the shape of a possible large order from the Paris Cab Company, those who took part in the competition made every effort to produce a successful machine.

The tests to which these vehicles were subjected were elaborated by a committee appointed by the Automobile Club of France, one of the members being the head of the Paris Cab Company. The conditions were made to imitate, as far as possible, those under which an ordinary hack does its daily work. The daily travel of such a vehicle is said to average 40½ miles (65 km.), of which only 28 miles (45 km.) are employed in actual useful work. The remaining 12½ miles (20 km.) is consumed on the road going to and from the stable and the cab stand, or returning to the stand after having carried a passenger to his destination, or else in driving slowly up and down the streets in search of a fare, as they often do. This travel extends over about sixteen hours, from 8 in the morning until midnight.

For many reasons the arrangements for the automobiles had to differ somewhat from the above conditions. The tests covered nine days, and were made over three separate routes marked out through the city, having a length of 37.3 miles (60 km.), each one being covered three times during the test.

These routes lay over some decidedly rough ground. The hills of the rues de Raynouard (route A), Magdebourg (route B), and Lepic (route C), with the pavements of the rue Menilmontant, left a vivid impression on the memories of the contestants and judges, for they have some bad streets even in Paris.

The routes were laid out to pass through some of the crowded streets, so as to include a starting and stopping test. The first day was devoted to making tests of the power of the brakes of each carriage on a 6 per cent. grade, and of the power of the motor by causing each vehicle to climb a hill 2000 feet long, with a rise varying from 8.2 to 8.8 per cent.

These same tests were repeated on June 11, after the carriages had made 335 miles (540 km.) during the nine days of testing, to determine what effect the vibration and strain to which they had been subjected might have had on the machinery. Careful readings were taken throughout of the energy consumed by the electric carriages at different speeds.

There were twenty-six vehicles entered, fourteen of which were electrically propelled. They were put up at a stable loaned by M. Clément, where there was a plant abundantly able to furnish the 115 kw hours at 110 volts required daily for refreshing the electric carriages. The accumulators being all furnished by the Fulmen Company, their care during the exhibition was supervised by two engineers from that company.

All the gasoline-motor carriages, with the exception of one, the Pengeot, withdrew from the contest. Of the fourteen carriages that started in the race, only seven finished with flying colors. One failed in a rather peculiar way, owing to the inflammability of its battery boxes, which were made of celluloid and took fire. Three makers were represented by the successful vehicles, Jenatzy, Kriéger and Jeantaud.

THE FULMEN ACCUMULATOR.

Inasmuch as all the vehicles in the contest and, in fact, nearly all in France use the Fulmen accumulator, a few words on the subject of this make of cell will not be out of place.

Perhaps the first thing to be taken up should be the proportion that the weight of the battery may properly bear to that of the carriage for a given speed.

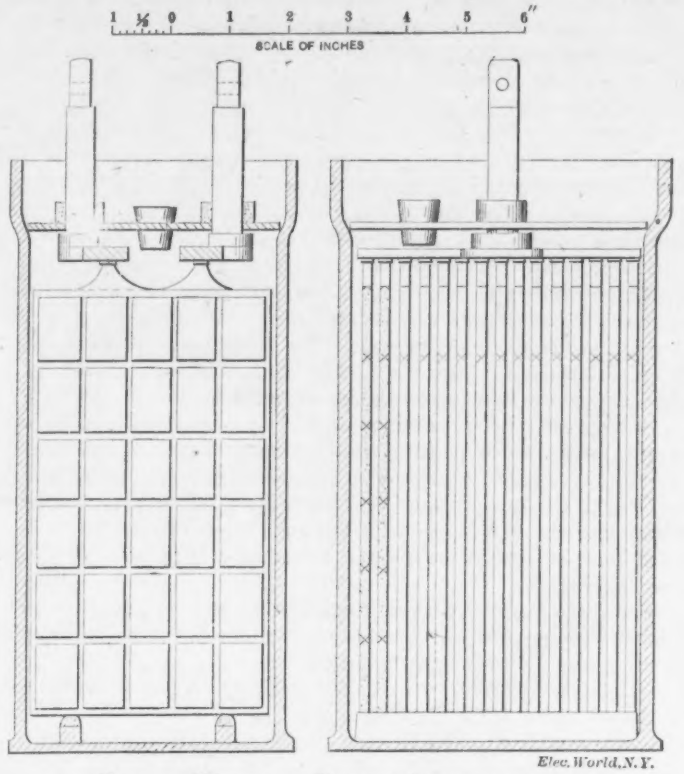


Fig. 2.—Details of Fulmen Accumulator.

Practical experiment made on good, hard, dry and level macadam road has given the coefficient of tractive effort as 0.0253 to 0.0344 for iron tires, 0.0228 to 0.0299 for solid rubber, and 0.0208 to 0.0248 for pneumatics.

Put the value at 0.025 and suppose a vehicle whose total weight is 2000 pounds be required to travel at 12 miles per hour or 17.6 feet per second. The tractive effort necessary will be $0.025 \times 2000 \times 17.6 = 880$ foot pounds per second. With a mechanical efficiency of 70 per cent. the accumulator must furnish 1257 foot pounds per second, or 1700 watts.

In one hour 12 miles will have been covered, and the expenditure of energy will have been 1700 watt hours, or 142 watt hours per ton mile, which is on the safe side, comparing it with Morris and Salom's figure of 123 to 136 watt hours per ton mile obtained in practice.

Now, with an accumulator whose normal discharge rate is 4½

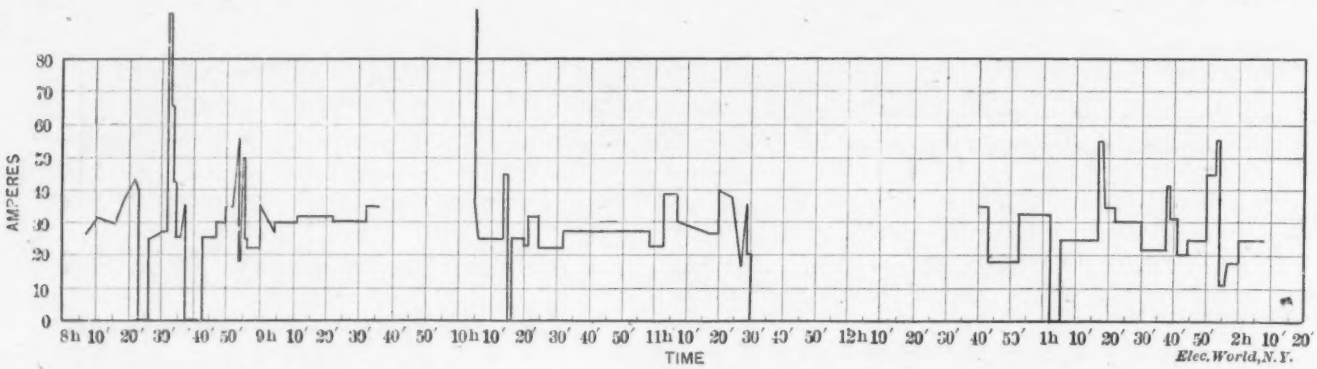


Fig. 3.—Discharge Curve for the Accumulator of Cab No. 13 Over Route B. Total Weight of Cab, 3960 Pounds.

Normal Conditions.
Duration of discharge, 5 hours.
Rate of discharge, 35 amperes.
Capacity, 175 ampere hours.

Observations.
Charge received at stable, 13,180 watt hours.
Duration of discharge, 4⅜ hours.
Average current, 25.8 amperes.
Average voltage, 88 volts.
Average rate of work, 2283 watts.

watts per pound of total weight, to give the required traction effort there will have to be 377 pounds per ton, as anything less will not keep it up to speed. If this battery is capable of 9 watt hours per pound of total weight, the distance will be limited to 24 miles for one charge. An increase in the weight of the accumulator permits an increase in the distance, but as the total must remain 2000 pounds the weight of the carriage will have to decrease, a process which can go on theoretically until it reaches zero.

Let us plot as abscissæ, as shown in Fig. 1, the theoretical possible variation in weight of the accumulator, which is from 0 to 2000 pounds, and against this on the axis of ordinates we will plot the difference between the total weight and the weight of the accumulator, 2000 to 0 (curve *A*); the distance which can be accomplished by an accumulator capable of 9 watt hours per pound, 0 to 137 miles (curve *B*); and the useful work done in ton miles (curve *C*), which equals the product of the useful weight (curve *A*) by the distance it is carried (curve *B*). Notice that the maximum point attained by *C*, the curve of useful work, corresponds to the value 1000 for the weight of the accumulator, or 50 per cent. of the total weight. In other words, no advantage can be gained by increasing the weight of the accumulator beyond 50 per cent. of the total. It will be a disadvantage to do so. Nor can we go below 20 per cent., or, as we have seen, the machine will not drag itself at speed; 30 to 40 per cent. is about what is met with in practice, and this corresponds to a distance of 40 to 56 miles at 12 miles per hour under the conditions assumed above. The effect of hills, starting and stopping, etc., would tend to bring down the figure for the distance.

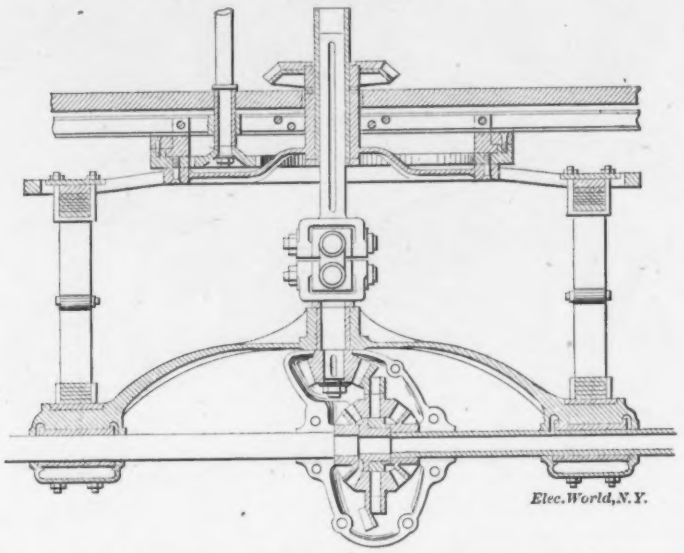


FIG. 4.—THE STEERING AND DRIVING GEAR OF THE DORÉ CARRIAGE.

The Fulmen accumulator is of the pasted type of cell, that is, the oxide or active material is mechanically applied, as distinguished from the Planté cell, in which it is formed by repeated reversals of current. The Planté type is a heavy accumulator, because the active material can only be made to extend inward on the plate for a small thickness; it has, however, a high rate of discharge, because the surface is large relatively to the capacity. The pasted type is lighter, because it is possible to have a larger quantity of active material on the same grid, but its surface is thereby reduced, which reduces the possible rate of discharge. The extra thickness increases the internal resistance, and also the tendency to polarize; the active material applied mechanically is also rather more liable to injury by excessive discharging or charging rates, resulting in pulverizing and cracking it away from the support, than is the case with the material formed by electro-chemical process. This disintegrating action results much more from excessive chemical strains than it does from any vibration strains to which the cells are subjected.

In considering the battery with relation to the automobile, the question of capacity per pound of cell is the important thing. High rate of discharge or charge is no doubt desirable, especially where any recovery of energy is to be made from the motor on a down grade. There is a tram line in Paris where the round trip consumes 8664 ampere hours and a recovery of energy of 1682 ampere hours is made on down grades, and here it pays to use a cell having a capacity of only 2 to 2½ ampere hours per pound, with a rate of 2¾ amperes. But the electric automobile has become practicable only with the advent of a cell giving 6 to 7 ampere hours per pound total weight, though the discharge rate possible is but 1⅓ amperes per pound. It takes 62½ pounds to furnish a useful kilowatt hour. Recovery of energy is still possible with this cell, but precautions must be taken to keep the charging current within certain bounds.

The plates of the Fulmen accumulator have each twenty-four rectangular tablets of active material supported by a grid of an alloy of lead and antimony. The edges of the tablets are V-shaped, so that they are held firmly in the grid. (See Fig. 2.) The plates are 5-32 inch thick, their weight being distributed as follows: 31 per cent. in the grids, 39.3 per cent. in the positive active material and 29.7 per cent. in the negative active material. Celluloid boxes have been used, but owing to their inflammability, which renders them liable to take fire from some overheated connection, they are to be discarded in future.

The manufacturers specify as normal a discharge rate of 0.065 ampere per square inch of positive plates for a continuous discharge of five hours. But the cell can furnish double that rate on a continuous discharge and four times for short intervals. At the normal rate the values for the Fulmen cell are as follows:

Discharge rate in amperes	1.36	per pound total weight of cell
Useful watts	2.40	" " " " "
Capacity in ampere hours	6.63	" " " " "
" " watt "	12.	" " " " "
Weight per kilowatt of storage	417	pounds
Weight per kilowatt hour of storage	83	"

If the rate of discharge be doubled, bringing it up to 5 watts per pound, the energy stored will fall to 9 watt hours per pound. And though it would require at that rate only 20 pounds to store 1 kilowatt capacity, it would be necessary to have 110 pounds to store a kilowatt hour as against 83 pounds before. By halving the discharge rate, the energy that can be stored may be raised to 13.6 watt hours per pound. In other words, a gain in power per pound entails a loss in energy per pound and vice versa, and it is well to remember that the life of an accumulator is shortened when worked hard.

In charging the cells the rate to be selected depends largely on the point which was reached when the discharge stopped. If they are entirely run out the current may be allowed to reach two amperes per pound; at the end of the charge it should not exceed three-quarters ampere per pound. The manufacturers recommend putting

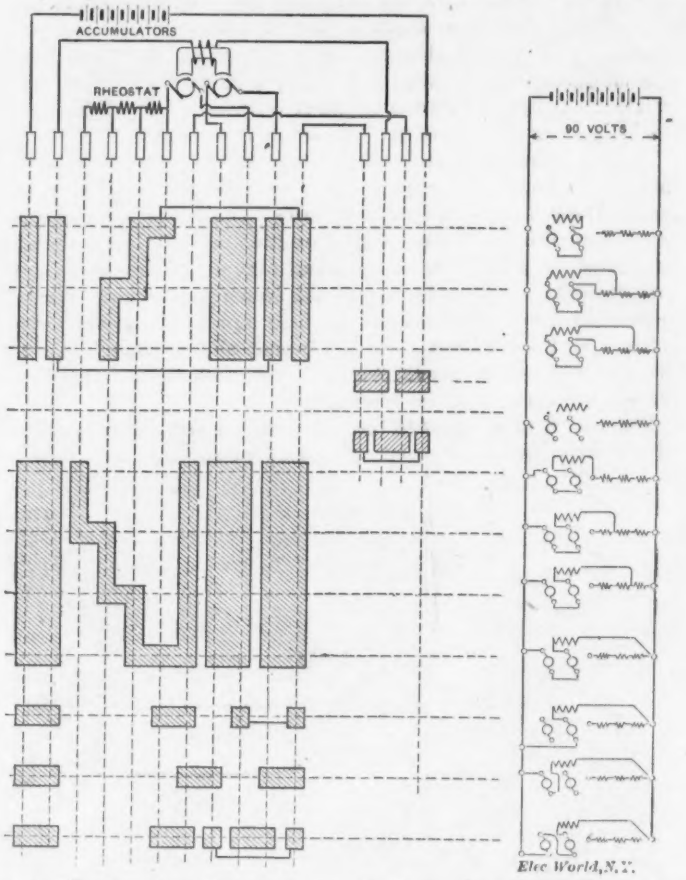


FIG. 6.—CONTROLLER DIAGRAM OF B. G. S. CIRCUITS. REVERSING CYLINDER INDICATED TO THE RIGHT. UPPER THREE POSITIONS ELECTRIC BRAKE.

the battery on a constant potential (100 volts for 44 cells) for seven hours. In this way the charging current diminishes automatically with the rise in counter e. m. f. of the cells, the charging being ended when the current reaches three-quarters of an ampere per pound.

The idea of charging from the motor while in motion on a down grade is at first sight a fascinating proposition, but practice does not quite bear it out. The chief value has been found in restoring the voltage by depolarizing the battery where it has become polarized by excessive discharge currents. The necessary mechanism for the connection adds greatly to the complication of the controller.

Under these circumstances the motor is intended to be used as a brake, doing work in the battery, and it is difficult, with such an arrangement, to avoid giving the battery a serious racking from time to time, due to excessive charging current resulting from a vigorous application of the brake. Of the three successful makers in the competition, one has eliminated the idea altogether; another, while retaining the apparatus for making the necessary connections, forbade his drivers to use it. The third made use of it frequently.

THE VEHICLES AT THE EXHIBITION.

The electric-cab competition was only a part of the exhibition for motor vehicles of all sorts, which, thanks to the public spirit of the members of the Automobile Club of France, is now a fixture in Paris, to be repeated every year. It would be a great thing for the industry in this country if something of the sort could be assured every year, say in Boston in connection with the Mechanics' Fair. Boston has been called the electrical city. It has many districts surounding it where the roads may be called good, and where the accompanying scenery is of the pleasantest. Why, then, should it not become the home of the electric automobile?

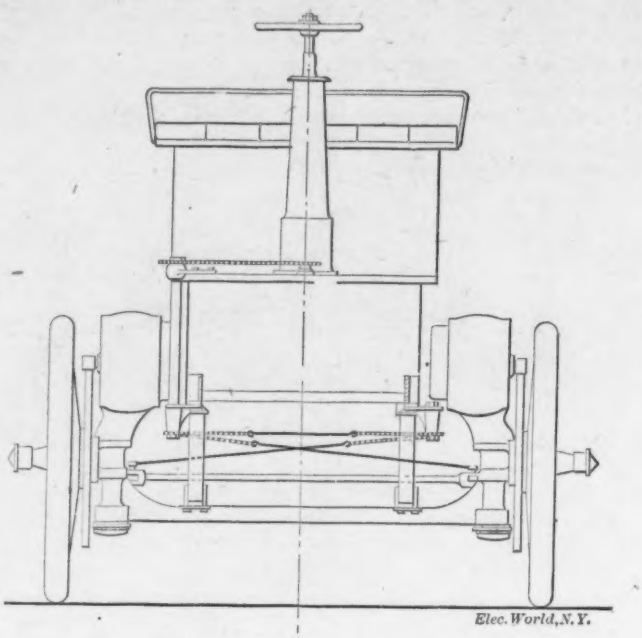
The carriages at the exhibit which for one reason or another did not compete will be taken up first.

First in order is the Doré carriage, noticeable as being one of the few retaining the old method of steering and of connecting the forward axle-tree to the carriage by a central king-bolt. This is also the driving axle, the motor being mounted in the forward part of the vehicle. To communicate rotation to the wheels, despite the motion permitted by the springs, the king-bolt (see Fig. 4) is made hollow and carries inside a rod which is made to turn with the king-bolt by a long key or feather, thus providing for the up and down motion. The lateral motion is taken care of by a universal joint in the rod which transmits the rotation to the crown gear of the differential by a bevel gear at its extremity. The whole is enclosed.

The forty-four cells are well hidden, their presence scarcely marring the outline of the vehicle at all, but they are inaccesible, a bad point. The cells remain always in series. The motor is series wound, its shaft meshing with a bevel gear on the king-bolt. The steering is controlled by a hand wheel, rod and pinion meshing, with a gear with internal teeth made fast to the frame of the axle-tree. The motor has three windings on the field and is controlled by three levers, one to open and close the circuit and introduce resistance, the second to short-circuit the field coil sections, and the third to reverse the current in the armature.

These operations occur in the order named as the carriage is started and brought up to speed. The lack of connection between the levers renders an inexperienced or careless driver liable to make mistakes which would result in injury to motor or battery. This carriage was prevented from entering the contest by the burning of its battery jars, which were of celluloid.

The carriages exhibited by the Compagnie Française des Voitures Electromobiles are built on the interchangeable plan; the truck or frame is of steel and built to receive any kind of body. The speed reduction gears are noiseless and the differential mechanism



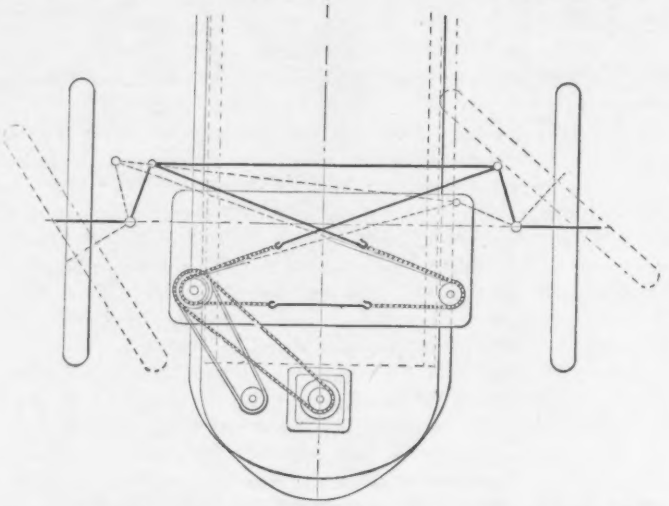


Fig. 12A.—Steering Gear of Kriéger Vehicles, Showing Motors on Steering Pivots.

is supported in boxes provided with an automatic oiling device. A Reynolds sprocket chain is used. The transmission machinery is supported on a hinged frame furnished with springs. Forty-four Faure-King cells carried in a double spring suspension supply the power; this battery is so arranged that it can be removed in three minutes. The motor is a Lundell with two commutators, an arrangement which furnishes a possible speed variation from 2½ to 11 miles per hour without changing the grouping of the cells, which

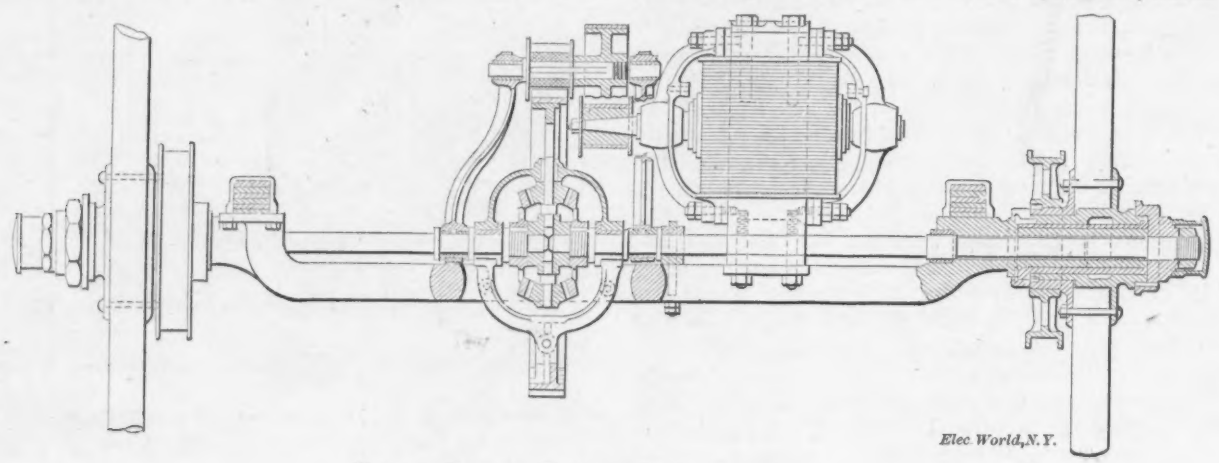


Fig. 7.—Driving Gear of Patin Carriages.

are always in series, or without the use of resistances. The controller has four speeds ahead and one back, and two notches for the electric brake which puts the two motor commutators in series with each other and the resistance. The motor starts with everything in series and the subsequent speed variations are accomplished by cut-

FIG. 5.—VICTORIA OF BOUQUET, GARCIN & SCHIVRE.

ting out the resistance, putting the commutators in parallel and, lastly, putting the field coils in parallel as the case requires. The forward axle-tree which steers is centrally pivoted and requires considerable force to turn it, and therefore the controlling wheel has to act through a worm gear, which makes the steering easy but slow.

The Paris General Cab Company has itself entered the experimental field. Its carriages are on the interchangeable plan as regards trucks and bodies. The company is, however, building a hundred or more for use in Paris, which differ radically from those which it exhibited.

The Mildé-Mondos Company exhibited a cab for street traffic use. It is solidly built, weighing 4000 pounds. A system of rubber springs is used between the carriage and the truck to permit the use of solid rubber instead of pneumatic tires. The battery is a Bristol of the pasted type and has forty cells; it weighs 1300 pounds, which is 30 per cent. of the total weight. It has a specific capacity of 4.2

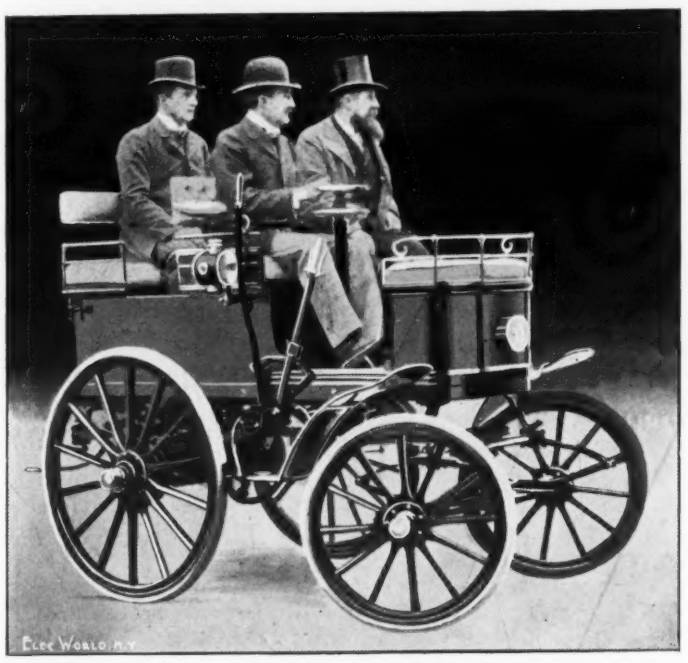


FIG. 9.—PATIN DOG-CART.

ampere hours per pound of cell. It will drive the carriage 30 miles at 8 miles per hour on one charge. The makers have used a battery of low specific capacity with the idea of giving it greater strength and staying power. The motor is a Postel, being rated at 2250 watts and 1800 r. p. m.; it has four poles and two field coils, a drum-wound armature and carbon brushes. It weighs 440 pounds with its case. The transmission presents no new features. The braking appliances include electric, band and shoe brakes. The brake pedal is linked with a switch which opens the circuit before the band acts. The steering gear is of the lever type, with independently pivoted wheels. The carriage is provided with wattmeter, ammeter and voltmeter. The voltage is kept constant and the speed variations are obtained by having field windings in sections and arranging them in different combinations.

The carriage exhibited by Bouquet, Garcin & Schivre, built on what is known as the B. G. S. system, is shown in Fig. 5, and is intended more especially for a private pleasure carriage. It has steel frames, is built on the interchangeable plan, and weighs 2200 pounds, while the battery weighs 770 pounds (about 32 per cent.),

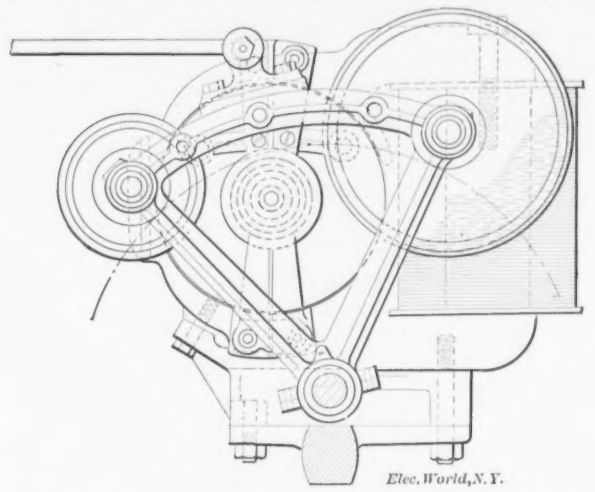


FIG. 8.—CHANGEABLE GEAR OF PATIN DRIVING TRAIN.

and is good for 60 to 90 miles, according to the kind of road. The cells are made by the makers of the carriage and have a capacity of 10 to 11 ampere hours per pound, at a rate of 1.3 amperes to 1.8 amperes per pound. The armature of the motor has two commutators and two windings on the same core. The number of turns in the two windings and consequently the counter e. m. fs. differ in the ratio of 5 to 3. By this means seven changes of speed are obtainable without altering the grouping of the cells or the number of turns of the field coils, the method of control being very much like the series-parallel system in use in street cars in this country.

The motor is started (see Fig. 6) with the armature windings in series with themselves, the battery and the whole rheostat. There are three starting notches, all the resistance being cut out at the fourth notch, when the speed comes up to 4 miles per hour. The next speed is 6 miles per hour, and is obtained by cutting out the

FIG. 10.—JENATZY DOG-PHAETON.

weaker armature winding. The sixth speed, 10 miles per hour, is obtained by substituting the stronger armature winding for the other. The maximum speed of 15 miles per hour is obtained by coupling the two armature windings in opposition to each other.

The motor is built for an average current of 15 to 20 amperes and at 12 miles per hour it makes 1500 r. p. m.; it is rated at 4 horse-power and weighs 88 pounds. The rise in temperature after five hours of service is 55° C., the electrical efficiency is 93 per cent., and the mechanical 87. Taking into account the transmission machinery the efficiency is 80 per cent., as measured at the wheels. The differential axle and the motor are accessible through a trap in the flooring and are made so as to be easily removable.

The latest form of controller has but one cylinder, which takes care of the reversing as well as its other functions. The one shown in Fig. 6 has two concentric but independent cylinders, the little one being for reversing. The steering is done with a lever, acting on the front wheels, which are connected to the front axle-tree by pivots. The electric brake is set by the controller, causing the motor to do work on one or two sections of the rheostat, or on short circuit, as the case requires. The vehicle carries an ammeter, a voltmeter and a wattmeter. The ammeter and voltmeter are in sight of the driver and are lit up at night. The wattmeter, together with the circuit-breaker, the fuses, and the charging and discharging switch, are all under the seat. The charge, as well as the discharge, is controlled by the controller.

The Compagnie Générale des Transports Automobiles exhibited a kind of dog-cart and a phaeton, in addition to the cab No. 13, which took part in the contest. They differed from it in having two

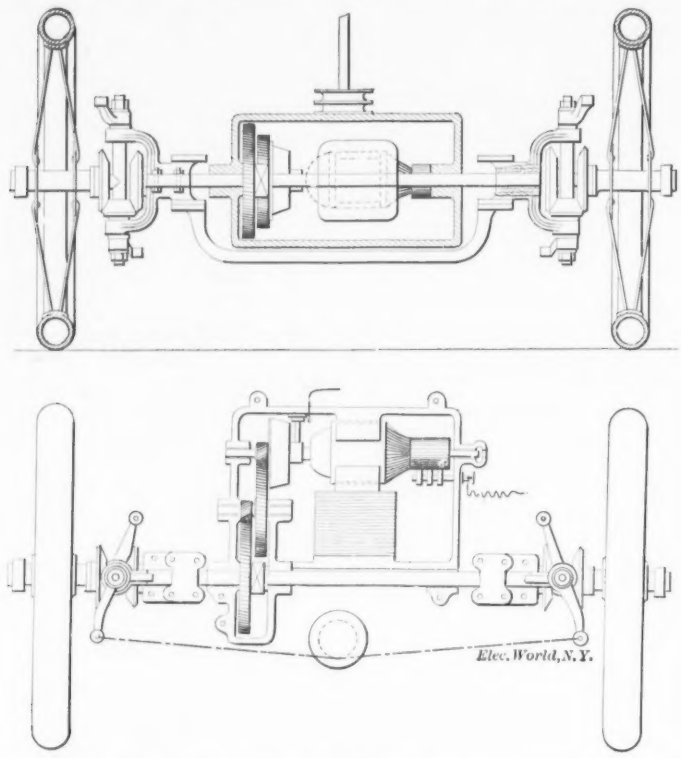


Fig. 12.—Driving and Steering Mechanism of Jeantaud Coupé, Showing Gearing Around Steering Pivots.

motors instead of one, and in leaving out the mechanical speed changer. The maximum speed obtainable is also greater, reaching 25 miles per hour.

The Pope Manufacturing Company had an exhibit, but as their carriages are described elsewhere in this issue (see page 483) they will not be described here.

It is no surprise to find the O. Patin Company, which has met with so much success in other electrical fields, entering upon the manufacture of electric automobiles. The accumulator used by this company is a new type for which great claims are made, but which has not been thoroughly tested. The motor suspension and mechanical speed changer are somewhat new. (See Figs. 7 and 8.) The rear wheel supports a steel bar frame parallel to the shaft and concentric with it at the wheel ends, but offset so as to be below it between the points where it supports the carriage springs. In the centre the bar opens out horizontally into an oval frame, to leave room for the differential gear and its case, the exterior of which is a gear. The motor is bolted to a plate which is clamped to this bar. The wheel or driving shaft is divided at the differential into two lengths, each of which is supported by a journal box just beside the differential gearing, and another at the point where it passes through the axle frame, this box being lined with bronze. A nut at each end secures the wheel hubs which are outside the frame to the extremity of the shaft. Each brake drum is made fast to the inner end of the wheel hub.

The motor shaft is supported by arms from the field poles, and carries a rimmed pulley concentric with which are three or four loose-fitting leather rings. (See Fig. 8.) Two other pulleys of different diameters carry gears and are mounted on an oscillating frame so that the gears are at all times in mesh with the main gear of the differential casing, while either of the pulleys themselves can be brought up hard against the leather rings on the motor pulley, being driven by the friction therewith.

This rather complicated arrangement makes it possible to change the speed-reduction ratio or to throw the load on the motor after the latter has attained full speed. In this way a sudden pull can be obtained of much greater intensity than the motor would otherwise be capable of. There is no danger of breaking gear teeth, as the gears never separate.

The motor is series wound and further speed variations are obtained by changing the number of field windings by the intervention of a controller. The usual band and shoe brakes are present, and the reverse connection is also used as a brake. A completed vehicle of this type is shown in Fig. 9.

Following are the descriptions of the automobiles which carried away the honors in the competition:

THE JENATZY PHAETON.

This vehicle, built by the Société Générale des Transports Automobiles, is intended to carry two passengers.

The wheel base is 6 feet 2¾ inches, and the wheel gauge 4 feet

Fig. 11.—Cab Jeantaud, Side View.

9½ inches, built to this gauge to permit the vehicle to run on the car tracks. The wheels are of wood, with metallic hubs and spokes shaped rather differently from ordinary cab spokes.

The motor is of the open type, and to protect it from the dust is placed inside the carriage body, together with most of the machinery, only the ends of the differential shaft with the chain sprockets protruding beyond the walls of the body. The motor is series wound and is rated at 4 to 5 horse-power, with maximum attainable of 10 to 12 horse-power.

There are two speeds provided for in the controller, 6 and 12 kilometres, 3.7 miles to 7.4 miles per hour. The battery is in two groups, placed in parallel at the lower speed and in series at the higher.

The sprockets, which are respectively of 6 and 36 teeth, are connected by a link chain. There are two speeds provided for mechanically as follows: In line with the armature shaft and connected with it by a universal joint is placed a shaft carrying two loose pinions meshing with two gears keyed to the differential shaft. A clutch is placed between the two pinions so that either can be made to drive the differential shaft, thus varying the speed in the ratio of 1 to 1½. This permits a change from 3.7 to 5.5 miles per hour and 7.4 to 11 miles per hour.

Intermediate speeds are obtained by introducing resistances in the

motor circuit. To make the controller as simple as possible all arrangements for restoring power to the battery on a down grade are left out.

The battery consists of two groups of 22 cells each, of the Fulmen make. Each group is in a separate box, one under the driver's seat

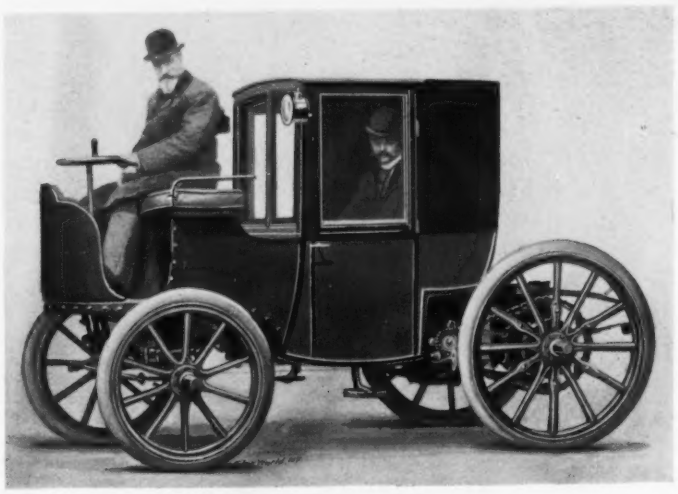


FIG. 13.—JEANTAUD COUPÉ.

and the other in a box at the back of the carriage. These receptacles may be opened by sliding up one of the panels.

The driver steers with a lever arm which acts on the forward wheels through a system of rods and hinges, turning the wheels about independent centres to which they are pivoted at the extremities of the forward axle-tree.

The brake pedal controls the band brakes acting on the differential axle. In addition to these a lever controls two shoe or spoon brakes, acting directly on the tires, and intended for use should the chain give way and render the others useless.

JEANTAUD CAB.

This vehicle, shown in the initial illustration and in Fig. 11, was built by Jeantaud, the fashionable carriage builder, and intended for two passengers. It is listed at 14,000 francs ($2800). It is shaped something like a hansom cab, the place of the horse being taken by the accumulator case supported on the forward axle. The driver sits behind, as in horse-drawn cabs, and has ready to his hand the steering wheel, controller, a pedal controlling a starting switch and the electric brake, and a lever controlling two band brakes acting on hubs made fast to the wood spokes of the wheels.

The useful or live load is about 10 per cent. of the total and the accumulator load is 29 per cent. of the total. The wheels are of wood, with metallic hubs and pneumatic tires. The motor and the reduction gears are encased; only the extremities of the shaft carrying the chain gears protrude. The motor, rated at 3½ to 4 horsepower, is bipolar, and has shunt and series field coils. Speed-reduction gears and chains are used to connect the motor with the rear wheels. Forty-four Fulmen cells, weighing 880 pounds, enclosed in two boxes in the case on the forward truck, form the battery. The controller will give four speeds, 4.3, 7, 9 and 11 miles per hour. Intermediate speeds can be provided by introducing resistance in the circuit with the electric brake pedal.

The steering is done by a hand wheel which turns a standard, the motion being communicated to the front wheels through rods and swivels. The axles of these wheels are pivoted at the extremities of the forward axle-tree. One turn of the hand wheel will deflect the steering wheels through an angle of 35° from their normal position, this being the limit. The vehicle is provided with band brakes, shoe brakes and an arrangement whereby the motor can be used as a brake.

Another Jeantaud vehicle drives through the steering pivots by means of bevel gears, shown clearly in Fig. 12. The vehicle itself is shown in Fig. 13.

THE KRIÉGER CARRIAGES.

The carriages of this maker are arranged with bodies separate from the frames, so that it is possible to alter the character of the carriage without changing the frame or truck.

The coupé (see Fig. 14) and victoria are arranged for three or four passengers without baggage, and are sold for 12,000 francs.

The driver's seat is over the front axle-tree. The driver is required to look after the steering wheel, the band brake pedal, and the controller which controls the speed and the electric brake. An ammeter and voltmeter, both dead-beat instruments, are placed on the top of the controller. The forty-four accumulators of the Fulmen type are in two cases, one under the driver's seat and the other behind the carriage. They can be got at by taking out a movable side panel.

Each carriage is supplied with two motors driving the front wheels, weighing 143 pounds each. The gears are single-reduction, the ratio being 16½ to 1. The motors are mounted on the steering pivots at the ends of the axle-tree (see Fig. 12a) and turn with the wheels when the direction of the vehicle is to be changed. The motors have four poles, one pair being series wound, while the other is shunt wound.

The large gear is mounted directly on the hub of the wheel instead of on the spokes, because in this way it is easier to make the gear run true, which obviates the necessity of using a flexible joint between the armature shaft and the pinion. It seems possible that the position of the motor would lead to its injury from the vibration of the wheel on rough pavement, but the experience gained in the competition proved that the pneumatic tire was all-sufficient for its protection.

The motor armatures are ordinarily connected in series and when so connected the same torque is given to both, even at different speeds, when rounding curves. This arrangement obviates the necessity of a differential gear, which is indispensable to motor vehicles driven from a single motor. When the higher speeds are reached, where the motors are connected in parallel, this automatic balancing of the torque is lost, and the driver is under the necessity of correcting with the steering gear any tendency shown by the vehicle to deviate from a straight line.

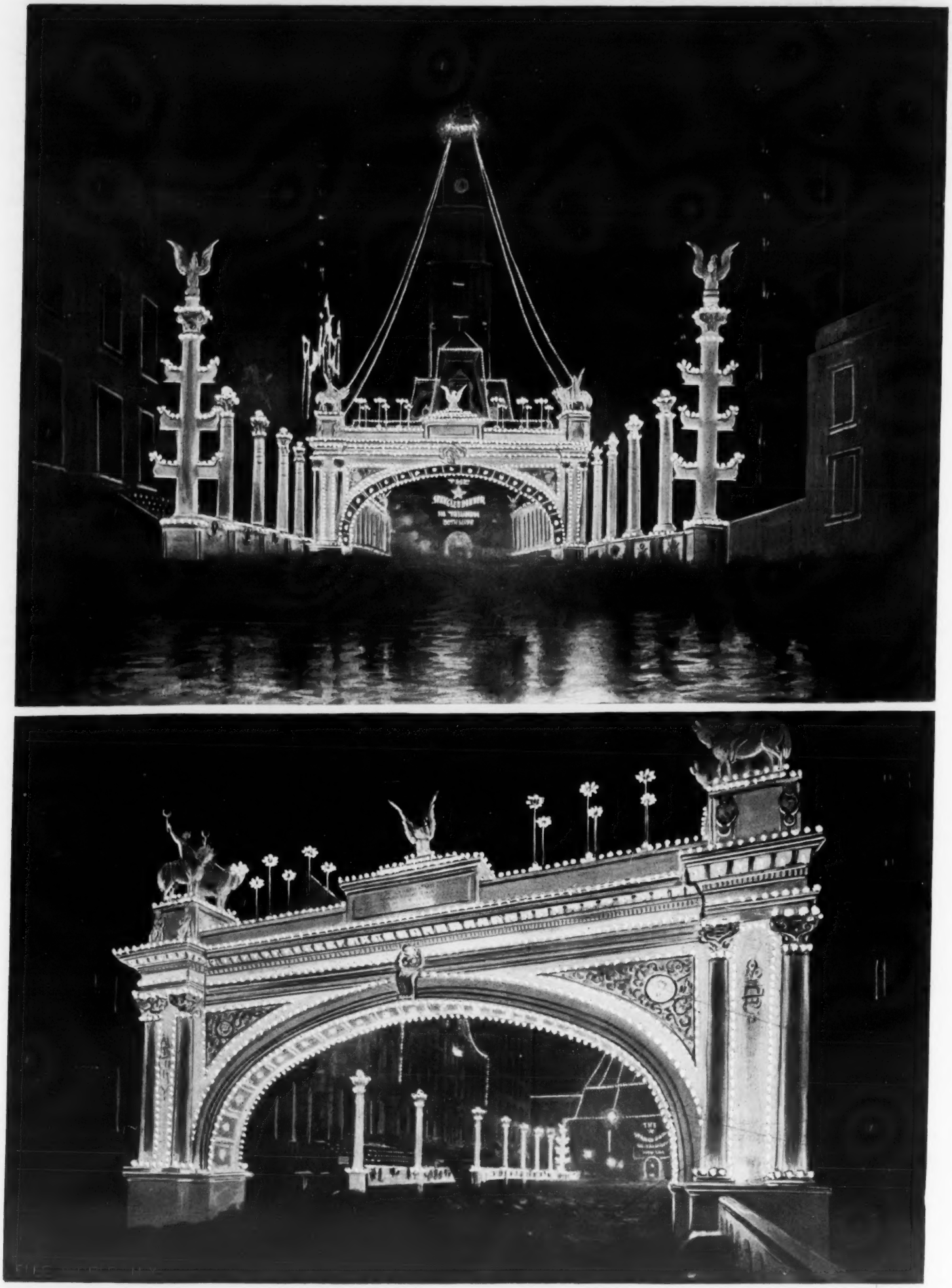
The controller is arranged for the following speeds: First Speed—1½ to 3⅔ miles per hour. Two groups of the battery in parallel and all four field coils in operation. Armature speed, 600. Second Speed—5 to 6 miles per hour. Battery as before. Shunt fields cut out. Armature speed, 900. Third Speed—7 to 7½ miles per hour. All the cells of the battery in series and all four field coils in operation. Armature speed, 1200. Fourth Speed—10 to 10½ miles per hour. All the cells of the battery in series shunt field cut out. Armature speed, 1600. Fifth Speed—12½ miles per hour. The motors are now connected in parallel and the full field is in operation. The cells remain all in series. Armature speed, 2050. Sixth Speed—15½ miles per hour. This speed corresponds to an armature speed of 2550, and is obtained by cutting out the shunt fields.

On a down grade the motor is generally used as a generator feeding back to the battery. If the hill is long enough there will be a quite noticeable recuperation of the battery. As the band brake

FIG. 14.—KRIEGER COUPÉ.

does not act when the carriage is running backward, it is necessary to rely on the motor to check any inopportune tendency to go down hill backward. This is done by keeping the controller moving alternately from rest to Notch 1.

(To be Continued.)



The Court of Honor and its Arch at the Philadelphia Peace Jubilee.

The Peace Jubilee in Philadelphia.

THE peace-loving citizens of Philadelphia devoted three days of last week to the expression, in the form of a "peace jubilee," of their joy over the termination of hostilities between the United States and Spain. Philadelphians are sometimes accused of being somewhat slow, but a stranger coming to that city on this occasion with that idea in his mind would certainly find it difficult to reconcile the reputation with the observed facts. If the Quaker spirit exercises any control over the actions of Philadelphians it is evidently overcome when, in the course of human events, it becomes necessary for the citizens to give expression to their love of country. The awakening of their patriotism on this occasion was as genuine as it was at the period 122 years ago which culminated in the declaration of independence, and they may well be proud of the success they attained in their latest effort.

As usual on such occasions, electric light for night illuminations constituted a very important feature of the celebration. By far the most elaborate effect was that at the Court of Honor on Broad Street. This extended for two blocks, and was a masterpiece of design and of exquisite artistic taste. Next to the Court of Honor in extent came the City Hall illumination. The 500-foot tower of this building afforded a means, which was readily utilized, of producing some extraordinary illuminating effects. The Court of Honor and the City Hall were the only illuminations in which the city itself was concerned. There were many private displays, however, that were very appropriate and artistically designed.

THE COURT OF HONOR.

The two blocks on Broad Street, between Walnut and Chestnut, were given up to a special feature, which was the centre of attraction and by all odds the most pretentious of all illuminations on this particular occasion. On it the greatest efforts of the city authorities were centralized, and it was here, directly opposite the building in which it has been stated that Presidents are made, that President McKinley and his cabinet, on Thursday, reviewed the great military parade from a grand-stand. This particular locality was very appropriately designated the "Court of Honor."

In design the Court of Honor was elegant and artistic in the extreme. Equidistant on each side of Broad Street, between Walnut and Sansom, were erected six white columns. The two end columns, at the corner of Walnut Street, were more conspicuous than their mates, both in size and design. They were somewhat taller, and from their opposite sides projected six ship-beaks, three on each side of the column. At the tops of the capitals of the columns were spheres, and on the tops of these stood large figures of the war bird, the American eagle, with spread wings, as if having just alighted for rest after leading the American forces to victory. The inner columns were plain, round shafts set on rectangular pedestals and surmounted with the graceful capital of the Corinthian order of architecture. The plainness of the shafts was relieved somewhat by two lions' heads placed diametrically opposite to each other on the surface a little below the base of the capitals. The framework of all the columns was of wood and the finish of plaster. The capital of each column was surmounted by a white sphere.

Next to the two innermost columns on this block was erected a most beautifully designed arch, which spanned Broad Street from sidewalk to sidewalk. The arch was 80 feet long and 45 feet high, the crown being 35 feet from the street and the swing of the arch about 12 feet. Its frame was constructed of wood. This was covered with plaster previously made up into sections from the plans. The various decorative pieces and figures were constructed and erected in a similar manner.

On the other side of the arch—north—were disposed sixteen columns precisely like those on the south side, and already alluded to. There were, therefore, twenty-eight columns in all, with the arch in a position midway along the line. The Court of Honor was illuminated by 4000 16-cp incandescent lamps, 2500 of which were used on the arch and 1500 on the twenty-four columns. In wiring the arch the feeders were carried up through the interior of each base, the branch circuits being brought out to the outside just at the spring of the arch, and laid down in place on the surface, underwriters' wire being used for this work. The seventy separate circuits were measured off and made up in the loft of a near-by building, the lamp sockets being at the same time properly spaced off and connected. All that was necessary then was to lay the circuits in their proper places on the arch. The longest of these ready-made circuits was 310 feet.

The feeders were carried from the underground mains to the columns in iron pipes laid along the gutters on each side of Broad Street, and the branch circuit for each column was carried up the shaft on the outside and encased in loricated tubing to the top of the pedestal. Each of the inner columns was illuminated by fifty-five 16-cp lamps with clear glass bulbs, each of the four large or end columns containing ninety similar lamps.

As to the arch itself, the distribution of the lamps was well designed and the bright points of light, with their reflections gradually receding to dark areas upon the arch structure, gave a most beautiful and charming effect to the beholder. The scene was truly fairylike, and the photo-engraver's art is weak in results in its efforts to portray such a picture as the eye sees it. There is only one way to appreciate the beauty of such a scene, and that is to see it. Since, however, few of the readers of this account were privileged to witness this fairy-like scene, an endeavor is made on page 476 to present views which will in a measure convey some idea of the beautiful effects produced by the night illumination of the Court of Honor, which was wired on the two-wire system, the feeders consisting of No. 0000 and 0 wire on one side and 00 and 0000 on the other. Besides the three main switches at the distributing points, each branch circuit was provided with a cut-out. There was a cut-out on each of the inner columns, and on each of the end columns two cut-outs were provided. Under the curve of the arch bare wire was used, while insulated wire was used on the rest of the work. The wiring here, as well as that of the sign on the south front of the City Hall, was done by the Sawyer Electrical Company, of Philadelphia, under the supervision of its chief engineer, Mr. W. Bartine. The work was one of considerable magnitude, and required the constant labor of a large force of wiremen for three or four days and nights. The result reflects great credit upon the resources of the Sawyer Company.

The current for the illumination was supplied by the Edison Electric Light Company from its Sansom Street plant for five hours on each of the three nights of the celebration. The Edison Company also furnished the lamps used. As the extra load upon the Edison station came after the peak, it was not necessary to make any extraordinary arrangements to provide the necessary power beyond, possibly, the service of an extra dynamo tender.

The committee on illumination for the peace jubilee consisted of Mr. Frank Miles Day, Mr. J. M. Huston, the architect of the arch, and Mr. G. H. S. Young, engineer, and much credit is due these gentlemen for the excellent manner in which they accomplished the peculiarly trying duties they were called upon to perform.

The Importation of Foreign Dynamos.

It may surprise American electrical engineers who have been congratulating themselves of late on the use of American electrical machinery in foreign lands to find that three large direct-coupled alternators have been built by Messrs. Brown, Boveri & Co., Baden, Switzerland, for an American gold mining company. The machines are of the fly-wheel field-magnet type,* mounted on the shafts of three cross-compound horizontal Allis-Corliss engines.

Sine Waves on Ocean Cables.

The Crehore and Squier synchronograph has recently been tested on the submarine cable of the Commercial Cable Company running between New York city and Canso, Newfoundland. A simple sinusoidal wave of impressed electromotive force is expected to give higher speed on cables with the same dielectric strain as it does on overhead lines with the same impressed electromotive force.

*See THE ELECTRICAL WORLD, January 8, 1898, page 60.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

MODERN TRANSFORMERS. Rhodes. Lond. "Elec. Rev.," Oct. 14; reprinted in "El'ty" (N. Y.), Oct. 26.—A short article pointing out the importance of the proper choice of transformers, and the great necessity of keeping the regulation under full control. Some American cases are cited showing the advantage of replacing small by large transformers. Attention is called to the fact that so many alternating-current stations fail to pay a dividend, and this is thought to be due to the fact that the management of alternating currents is not sufficiently well understood and their application is not manipulated with sufficient skill; he emphasizes the necessity of a sound theoretical training in this branch, as well as a practical knowledge. The question of regulation is most important of all; he claims that the alternating current is the proper one to use if it is properly managed; it is an admission of incompetency to allow such a station to be a failure.

CARBON BRUSHHOLDERS.—Lond. "Elec. Rev.," Oct. 14.—After referring to portions of the article in THE ELECTRICAL WORLD, July 23, some figures are given for carbons made by "Le Carbone" Company. For the "special quality" of their brush the pressure on the commutator should be 100 grammes per sq. cm. of contact surface, while for their "electrographitic" carbon it should be 50 grammes; the special quality is a fine, close-grained carbon, which will carry currents up to 10 amperes per sq. cm. of contact, while the electro-graphitic carbon has been transformed into graphite by submitting it to the temperature of the electric arc; the conductivity is then four to five times greater than of the preceding brush, and it will carry currents at the rate of 20 amperes per sq. cm. A table gives the prices of these brushes of various sizes. Another table gives the prices of the Partridge self-lubricating brush, which is extensively used on electric railways in the United States.

ALTERNATING-CURRENT MOTORS. Guilbert. "L'Eclairage Elec.," Oct. 8.—Brief, illustrated descriptions of various systems taken apparently from patent specifications, with special reference to the methods of starting them.

Lights and Lighting.

ARC LAMP CARBONS.—"L'Elec.," Oct. 8.—The results of some measurements made of the resistance of the Henrion carbons, five of which were homogeneous and five cored.

ELECTRICITY FOR LIGHTING.—"Elec. Eng.," Oct. 14.—Three short essays on the practical advantages of electricity for lighting purposes.

THEATRE LIGHTING.—"El'ty," Oct. 26.—A reprint of the article noticed in the "Digest" Oct. 22.

ECKMUEHL LIGHTHOUSE.—"El'ty," Oct. 26.—An illustrated description of this large French lighthouse, taken from foreign articles recently noticed in the "Digest."

Power.

KERKA WATER-POWER PLANT. Giovanenilli. "L'Eclairage Elec.," Oct. 8.—In this continuation of the description of the project for the La Kerka falls the electrical features are described. Multiphase alternators of 1100 kw at 8000 volts are proposed; the energy is to be used chiefly for power purposes, as distinguished from lighting.

MINING PLANT. Holzner. Lond. "Elec.," Oct. 14.—An abstract of a translation of his article from an Austrian journal, describing the electrical power transmission plant in the Ziegler shaft; 130 horse-power is transmitted at 500 volts by continuous currents.

ELECTRICAL REFRIGERATION. Fay. "Elec. Eng.," Oct. 20.—The concluding portion of his article (see "Digest" Oct. 22). After illustrating a number of the auxiliary apparatus he makes an estimate of the cost of such refrigeration. He assumes 5 cents per kw (presumably hour), and that "1 kw per hour for twenty-four hours will effect the equivalent of 1 ton of ice melted." From this he finds the calculated cost is $1.50, in which, however, labor does not seem to be included (presumably this means for producing 1 ton of ice); ice, he states, sells from $4 to $20 per ton.

CANON CITY. Wade. "Elec. Eng.," Oct. 20.—A very brief description of this three-phase transmission plant, in which a voltage of 20,000 is used.

Traction.

SURFACE CONTACT SYSTEM. Thompson and Walker. Lond. "Elec.," Oct. 14.—A reply to a criticism of their system (see ELECTRICAL WORLD, Oct. 22) by Brown (see "Digest" last week). The criticism was based on the incorrect supposition that the surface contacts are alive; they are, on the contrary, all dead except those under the car. In reply to his statement that there would be a serious leakage current, they state that their system can be worked with either series or shunt coils, the latter being in use on their experimental track; they prefer the shunt method because this abolishes the complication of interconnections and the cars may be run in either direction; the loss of leakage through the shunt coils is therefore quite unimportant; the coils take only 3 per cent. of the average current of the car. The true leakage at the distant end at the surface of the ground in dry weather is too small to be measured; even in wet weather it is quite small. In reply to his preference to the Diatto system they claim that a very large number of ampere turns of exciting current are continually required in that system for very weak mechanical forces; in their system the mechanical forces to operate the switch are twenty times as great as in the Diatto system, while the number of ampere turns required is less than one-fifth.

GLASGOW.—Lond. "Elec. Eng.," Oct. 14.—A brief reference to the recent opening of this electric railway. The description is chiefly introductory in character; illustrations are given of the new type of cars, the entrances to which are in the middle.

COST OF OPERATING ELECTRIC RAILWAYS.—"L'Elec.," Oct. 8.—An abstract of an article on the Koppel system of transportable electric railways, with tables of the calculated costs.

TRAMWAY OVER CHILKOOT PASS. Burkholder. "Jour. of El'ty," Sept.—An illustrated description of the construction of the rope tramway over that pass leading to the Klondike. It consists of a traction cable on which run two buckets like coal conveyors and pulled by means of a cable, which latter is drawn by a 15-hp two-phase induction motor, the current for which is generated at a distant station. It is used for freight only.

LONDON CENTRAL RAILWAY. Hall. "Elec. Rev.," Oct. 26.—A brief description of a visit to this plant, which is under construction.

Installations, Systems and Appliances.

SUBDIVIDING CENTRAL STATIONS.—"Elek. Zeit.," Oct. 13.—An editorial discussing the question of whether a city should be supplied from one or several central stations, the latter having been urged in order to guard against cases of fire in the station, such as recently occurred at Chevres. It is thought that the claims for using several stations have been exaggerated, and that to duplicate a station or divide it into two independent ones would increase the cost of the current so much that the advantages of the cheaper power would be lost. There is no more reason to duplicate the lighting stations than the water, gas, telephone and other similar works, on which the city is dependent. When a station becomes very large, however, or when a water-power station has a steam reserve, certain precautions to divide it by fireproof partitions into parts are recommended.

VIENNA.—"L'Ind. Elec.," Oct. 10.—An abstract of the statistics noticed in the "Digest" Oct. 8.

Electro-Physics and Magnetism.

CONTINUOUS CURRENT IN THE ALTERNATING ARC. Eichberg and Kallir. A reprint under separate cover of a paper read before the Imperial Academy of Sciences in Vienna, Vol. 107, May.—A description of researches made with the apparent continuous currents produced in the alternating arc between different kinds of electrodes. If an alternating arc is established between a metal rod and a carbon, then a tangent galvanometer in the arc circuit shows a continuous current in the arc from the metal to the carbon, and a voltmeter at the arc shows a continuous voltage in the direction of carbon-metal. This phenomenon occurs when there is a drop of molten metal on the metallic electrode and when the arc burns quietly; cored carbons were used; iron, aluminum, copper and nickelline were used as electrodes, but the observations were difficult with the aluminum. Measurements of all the factors were carefully made, and the results are given in tables; for all the different metals the continuous current and voltage have approximately the same values It has been shown that in a continuous current arc there will be a lower voltage when the current is from the metal to the carbon than when in the opposite direction, and that the voltages are different for the different metals. The current and voltage curves were also measured in the case of the alternating arc, the results being given in curves, which show that the formation of the arc from carbon to iron involves the production of a great resistance, but whether it is a true resistance or a counter e. m. f. was not apparent; this explains the almost complete interruption of the current in the direction of the carbon to the iron, which checks that current, but allows the other to pass. The phase-shifting produced is quite appreciable with a machine of high self-induction. The fact that the arc from the carbon to the iron was not formed was shown photographically, the illustrations being reproduced for six phases, differing by 60°. The curves show that continuous current and voltage values are affected by the alternating e. m. f. and the phase shifting. The almost complete interruption in the direction carbon iron produces remarkable phenomena when such arcs are connected in series or in parallel; the latter are discussed, as are also experiments with an exploring

carbon introduced in the arc. An alternating arc between a metal and carbon therefore acts like a valve, allowing a current in only one direction to pass; they connected a battery of accumulators with such an arc and found that about the best efficiency of conversion of the alternating into direct current was 30 per cent. They then made tests of the arc between carbons of various kinds and positions, and found direct currents; when the upper was cored and the lower homogeneous or the reverse, or when they were horizontal, a continuous current was produced, the largest when the cored carbon was the upper; in all three cases the continuous current was from the cored to the homogeneous carbon, the latter being positive to the former; some numerical results of the observations are given. These direct currents seem to be the resultants of two continuous currents, one dependent on the position and the other on the constitution of the carbons.

ALTERNATING CURRENT CALCULATIONS. Lyle. Lond. "Elec.," Oct. 14.—The first part of a series of articles in which he endeavors to deduce a theory of currents produced by harmonical varying e. m. fs. in branched and mutually inducing circuits, to something of the simplicity of the theory of steady currents in branch conductors. He assumes a knowledge of the method of representing by means of a diagram the relations between the amplitudes and the phases of such e. m. fs. and currents in a connected system of conductors; he also assumes a knowledge of the principle of the composition of vectors in a plane. He shows how to deduce the modified forms of Kirchhoff's laws that apply to a network with resistance, self-inductance and capacity; the form of the modified laws is exactly the same as that of the usual and better known laws. He applies his method to the Wheatstone bridge and a transformer with a moderate amount of hysteresis, which latter he reduces to practically the same form of solution as the simple case of a transformer in which hysteresis is neglected; he also solves, in a few lines, the problem of determining the winding and constants of the conductor for the alternate poles of the stator of a rotary field motor when the remaining poles are wound with a continuous conductor, which, in parallel with the other, will split the current to produce a rotating field. His analysis is applicable to a variety of problems. He introduces letters to symbolize certain definite portions. Editorially the method is said to be a distinct advance on our previous means of attacking these important problems.

DETECTORS OF ELECTRIC WAVES. Pochettino. "L'Elettricista," Sept.; abstracted in "L'Ind. Elec.," Oct. 10.—A classification of all the known processes for detecting electric waves; each of them is separately discussed; he finds that there are twenty-one, which are briefly as follows, the specific processes being numbered in succession: Among the spark detectors there are those which are due to the luminous effects; at the ordinary pressure, the Hertz resonator (1) and the Righi mirror (2); at low pressure, the Geissler tube (3). Chemical effects: In an explosive medium (4), with sensitive iodide of potassium paper (5). Ionization of air: At the ordinary pressure, the battery and bell (6), the dry cell and electroscope (7), the condenser and telephone (8); at low pressure, the Zehnder tube with accumulators (9), the Zehnder tube with dry cell and electroscope (10), the Righi tube (11). Detectors without sparks: Physiological effects (12), ponderomotive effects, electrostatic (13), electrodynamic (14), magnetic effects (15), thermic effects, dilatometer (16), bolometer (17), thermo-electric pile (18), diminution of the resistance of contact (coherers, etc.), metallic contact (19), "reseau" (20), tubes of filings (21).

ELECTRO-MAGNETIC WAVES. Turpain. "L'Eclairage Elec.," Oct. 8.—A long abstract of several of his papers from the Transactions of the Bordeaux Society of Physical and Natural Sciences. In the first he reviews the various processes of observing electrical resonance and describes another discovered by him. The second is on the Hertz resonator, it being an application of the above mentioned process for studying the field produced by an exciter and two parallel wires. This is followed by a discussion of this system by Duhem. The next is on the investigation of the field produced by a single wire.

NEW ELECTRO-THERMAL RELATION. Wiedeburg. "Wied. Ann.," No. 9; abstracted briefly in Lond. "Elec.," Oct. 7.—He discovered a new relation between the electrical and the thermal properties of metals; the metals can be arranged according to their emissivities in a series which corresponds to their thermal and electrical resistivities—that is, the higher the specific resistance the greater is the power of radiating heat; the law is only approximate.

TWO PHYSICAL HYPOTHESES. Juppont. "L'Ind. Elec.," Oct. 10.—A short article in which he advances two hypotheses, the object of which is to connect more intimately work, kinetic energy, heat, the law of conservation of energy and the law of the inverse square of the distance; the deductions are theoretical, from the equations of the dimensions. The first hypothesis is that temperatures and the square of the velocity are homogeneous quantities—that is, the temperature of a body is proportional or equivalent to the square of the velocity of its molecules. The second hypothesis is deduced from the comparison of the static and dynamic equations of force, and is that the square of the time of the revolution of a gaseous molecule is inversely proportional to the density of the gas; or the square of the velocity is equivalent to a potential; the temperature of a body thus represents the relative potentials of its molecules.

DISSIPATION OF INCANDESCENT PLATINUM WIRE.—"L'Ind. Elec.," Oct. 10.—When a platinum wire is heated to incandescence in a vacuum bulb, particles of the platinum are projected on the walls of the bulb, forming a sort of mirror; an analogous phenomenon occurs with the carbon filaments of incandescent lamps. Stewart investigated this phenomenon and found that at atmospheric pressure this dissipation is less as the incandescence is prolonged; the humidity of the air has no action on the phenomena; the dissipation diminishes with the pressure; for platinum it is reduced to two-thirds between the atmospheric pressure and 1.25 mm; in nitrogen and hydrogen it is insignificant, but in oxygen it is much greater; it is thus shown that oxygen is the chief cause. If this is also the cause for the action of carbon it would indicate that in exhausting the lamp bulbs an inert gas should be introduced, which, in being pumped out, will carry off the last traces of oxygen.

APPLICATIONS OF ELECTRO-MAGNETIC SCREENS. Du Bois. "L'Eclairage Elec.," Oct. 8 and 15.—A long French translation in abstract of his paper which was noticed in the "Digest" July 9.

GEOMETRIC THEORY OF THE MARINE COMPASS. Ravier. "L'Ind. Elec.," Oct. 10.—An abstract of a French Academy paper.

ELECTRICAL PROPERTIES OF ARC VAPORS. Merritt and Stewart. "Phys. Rev.," Sept.—Oct.—A long article describing experiments which were undertaken to study in detail the conducting power possessed by the vapors from the electric arc between carbons; the difference between these vapors and those ionized by X-rays are compared. The chief conclusion is that these vapors possess the power of discharging electrified bodies, and that in general the properties of these vapors are similar to those of gases which have been acted on by X-rays or the gases from a flame.

TERRESTRIAL MAGNETISM.—"Terres. Mag.," Sept.—Reprints in the original languages of the papers presented at the recent International Conference on Terrestrial Magnetism and Atmospheric Electricity, other reprints or abstracts of which have already been noticed in the "Digest." The same issue also contains a communication by Abbe on Eschenhagen's elementary magnetic waves, with a reply from the latter.

Electro-Chemistry and Batteries.

COPPER-DEPOSITING PROCESS. Kershaw. Lond. "Elec. Rev.," Oct. 14.—A brief, illustrated description of the plant at Widnes, England, where the Dumoulin process is used for making copper tubes and sheets. The copper is deposited on a revolving mandril like in the Elmore process, from which it differs merely in the method of obtaining smooth, dense deposits with currents of high densities; in the Elmore process agate burnishers were used, but in the present one strips of sheepskin are held over the top of the revolving drum so as to prevent any roughness in the deposit. Formerly the plant was used only for making sheets, but now tubes are also made. The solution contains about 7 per cent. sulphuric acid and 40 per cent. of cupric sulphate; the electrolyte is maintained in violent agitation by the revolution of the mandril, which is a hollow cylinder of copper 16 inches in diameter; the mandrils are horizontal, and only the lower half is immersed; the continual rubbing of the sheepskin keeps the deposit smooth; the anodes are thick copper plates; the mandril is revolved at a high speed, thus keeping the electrolyte in rapid circulation. Normally it requires about ten hours to deposit 44 pounds of copper, and the tube thus formed on the mandril weighs about 14 ounces to the square foot; the current density is between 35 and 40 amperes per square foot of cathode area, whereas 20 amperes is the maximum now obtained in electrolytic refineries; the output is greatly increased by the use of rotating cathodes; the voltage required is 1.6 per vat. The tube formed by the deposit on the large mandril is then slit longitudinally and rolled into a plate; the stripping, when it is desired to keep it a tube, will be done by means of hydraulic pressure. The plant, at its full capacity, can produce sixty sheets per day. It is essential to filter and cool the electrolyte after each passage through the vats.

PRIMARY BATTERY. O'Keenan. "L'Ind. Elec.," Oct. 10.—An illustrated description of his new primary battery, the positive plates of which are recharged by the air; the cost of the energy is said to be less than for any other primary battery. The positive plates are made of spongy lead like the negatives of a lead accumulator; when exposed to the air these are oxidized, and if then placed in dilute sulphuric acid a sulphate of lead is formed, after which the plate is ready for use. It is then placed in a vessel containing water with some sulphate of zinc, the other pole being a zinc plate; the sulphate of lead plate contains the necessary acid for the electrolytic action in the form of inert sulphate of lead; there will be no action on open circuit, but when the circuit is closed the sulphate of lead will be reduced to metallic lead and the zinc will be dissolved at the rate of 1.22 grams per ampere hour per cell. In constancy this battery is like the Daniell cell, the reactions of which are almost identical; the two chief qualities of the Leclanché and the Daniell cells are therefore united in this (except the high voltage of the former). When the lead plate is discharged it is recharged by exposing it to the air and then sulphating it in the acid; instead of exposing it to the air it may be left standing in rather concentrated acid. Occasionally some of the liquid will have to be drawn off from the bottom of the batteries and fresh water added. The zinc sulphate which is formed is an excellent disinfectant and may be used as such. A capacity of 20 to 30 ampere hours per kg of lead is obtained; it is even greater with frames of aluminum; several discharge curves are given; for a weight of the lead plate of 7 kg the following was obtained: e. m. f., 0.5 volt; available difference of potential, 0.5; current, 6 amperes; capacity, 187 ampere hours or 91

hectowatt hours, 26.7 ampere hours per kg and 13 watt hours per kg. The retaining cells are made of tinned iron in the form of rectangular boxes; these are protected by the device of connecting the zinc plate with them, the action being that, owing to the couple formed, the zinc protects the tinned iron, while at the same time it is claimed that the zinc is not consumed (if, however, a local current actually flows it is evident that the zinc must be consumed in proportion); such retaining cells are light, durable and cheap. In conclusion an illustrated description is given of the practical form of such a battery. With a weight of 7.5 kg of lead plates the internal resistance is about 0.0025 ohm; the normal discharge rate is up to 10 amperes with a useful voltage of 0.5; at 60 amperes it is 0.4, but there is no deterioration of the plates, although the efficiency is not so good. He calculates the cost of operation; for an output of 4.8 hectowatt hours the cost is at the rate of about 53.2 cents per kw hour on the basis of a useful voltage of 0.48; allowing 10 per cent. for the fragments of unconsumed zinc brings the cost up to about 60 cents, which is claimed has never been reached by any other primary battery.

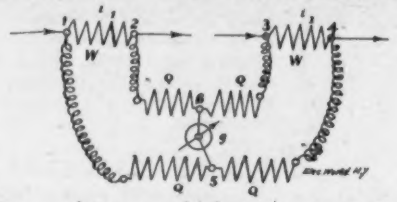
MARQUAND ACCUMULATOR.—Lond. "Elec.," Oct. 14.—A brief description of this accumulator, which is being introduced in England. The plate is a sort of compromise between the Planté and the Faure plate, the advantages of both being claimed to be combined. A ribbed but unperforated plate is cast in lead and then packed in sulphur, and subjected to heat up to the melting point of lead, at which temperature it is kept for about an hour. The surface is thus converted into a sulphide, which is then formed into spongy lead in an electrolytic bath of dilute sulphuric acid; the positive plates are formed by reversing the negatives. The parts of the plate which are not to be formed are protected from the action of the sulphur. It is claimed that under the conditions which promote sulphating in the ordinary plates the initial presence of the sulphite in this plate encourages the formation of an easily reducible sulphide in preference to the irreducible sulphate. A brief reference is made to a report by Thompson on tests of these cells. The plates weigh 28 pounds and the acid 5.5 pounds, each plate having an area of 45 square inches on each face; the limiting charging and discharging voltages were 2.4 and 1.8 with a constant current of 10 amperes; the mean ampere-hour output was 49.66, and the watt efficiency 87.8. At 20 amperes the capacity was 37.5 ampere hours and the efficiency 75.6. The elements can be made, formed and finished with twenty-four hours, as compared with a week for most other types.

COST OF REFINING COPPER.—"Eng. and Min. Jour.," Oct. 22.—A note stating that the cost of 1.3 cents per pound for refining copper electrolytically, which was given in a report of the Anaconda Company, was a very high one. It is stated that the charge by the custom works rarely exceeds 1 cent per pound, and that it is frequently done at ⅞ cent; as this naturally involves a profit, the cost must be less. The charge for refining cathodes is as low as ⅛ cent per pound, and 0.15 cent is not an uncommon rate.

ASHCROFT PROCESS. Ingalls. "Eng. and Min. Jour.," Oct. 22.—An article on this electric process for the treatment of mixed lead and zinc sulphide ores.

Units, Measurements and Instruments.

INSULATION INDICATOR FOR DISTRIBUTION WIRES. Kallmann. "Elek. Zeit.," Oct. 13.—The first part of the reprint of a long paper read before the Union of German Electrical Engineers last summer. After a long introduction, in which he points out the advantages which an instrument would have for indicating by direct reading the conditions of insulation of mains and distributing wires, he describes the principles of an instrument which he devised for doing this; no such instruments exist at present. He discusses the disadvantages of the system used so much in the United States, consisting of two incandescent lamps in series between the two mains, with their junction point grounded, thus forming the usual ground detectors; if one or the other of the two wires is grounded the lamp connected with the other will burn more brightly; in three-wire systems this can be applied only to the outer wires, and even then the indication is not certain, as the earth connection of the middle wire will affect the indication; even in the simplest two-wire system, however, the indication is not reliable, for when both lamps are equally bright it is no indication that the two wires are not equally grounded; such detectors therefore give only relative, but not absolute, indications. The same applies to the similar method in which the lamps are replaced by two voltmeters; it is only when the resistance in connection with the instrument is changed, or if the instrument is applied successively in different ways, that further information can be obtained from which the insulation can be calculated by means of formulas, which he gives. He concludes that the use of earth potential can therefore not be used as a basis of such an indicator. His instrument is in principle as follows: Suppose an ampere meter to be inserted in each of the two wires at the generator end; when there is no leakage they will read alike, but when there is leakage they will read differently by the amount of current which returns through the earth. It would be practically impossible, however, to measure such small differences in this way, and he therefore replaces the two ampere meters by a single instrument having a differential winding, thus reading only the difference between the two currents. It thus indicates the losses through the earth directly; it is independent of the potential of the earth, of the voltage, of the exciting load at the time or of grounds in other branches of the same network of wires, whether such ground connections are intentional or otherwise. In practice he suggests several different forms; in one of these there is a resistance in each of the mains, from the terminals of which wires are led to the differential galvanometer, suitable balancing resistances being placed in the four galvanometer circuits. In place of the differential galvanometer, the Thomson double-bridge method, shown in the adjoining figure, may be used (this seems to be the preferred method), in which case the galvanometer has only a single winding, it being connected between two points in



the middle of two resistances which are connected somewhat like the coils of a differential galvanometer in the above-described case, except that each resistance is connected between the positive indicator wire from the one main and the negative indicator wire from the other main, as shown, instead of between the positive and the negative indicator wires from the same main, as it would be in the case of the differential galvanometer. He then begins to describe the chief applications of his system with reference to the following cases: As applied to a single wire; to show the stray currents in the rails of an electric railway; to a two-wire system to indicate the total earth current; to a three-wire system; to a two-wire transmission, to indicate the earth currents from the transmission line and from the sub-station, separately. In the application to a single line a series resistance is placed at the beginning, and an exactly equal one at the end of that single line; from these resistances the wires are led to the indicator; any current loss to earth between these two will thus be indicated in the instrument; in this way it can be applied to single-line circuits like those for trolley lines. To apply the system to the leakage from rails of an electric railway he connects the instrument to two points at the beginning of the line of rails, and to two points at the end, thus using definite portions of the rails as the series resistances mentioned above; an example is worked out showing that if the length of rail which is used as a resistance at each end is 30 metres (about 100 feet), and the distance between them several kilometres, the current through the rails being 100 amperes, a direct-reading Weston galvanometer would give a deflection of about 5° for a loss of current of 20 amperes; a d'Arsonval galvanometer will give about ten times this deflection. The paper is to be concluded.

MEASURING THE FALL OF VOLTAGE. Leconte. "L'Elec.," Oct. 8.—A note describing a practical process for measuring directly the fall of voltage in distribution wires; he has used the method with success. An assistant at the switchboard notes the voltage every five minutes and then suddenly breaks the circuit, noting the time; the second, with a watch and voltmeter which have been carefully compared with the others, measures the voltage at the distant end. The results obtained agree very well. He suggests that a bell might be used on circuits containing inductive resistances, and which should therefore not be opened. (Why not simply insert a slight resistance into the circuit instead of breaking it, thus giving a signal without breaking the circuit? If the watches have been compared, even this seems unnecessary.)

HYSTERESIS AND FOUCAULT CURRENTS. Niethammer. "Elek. Zeit.," Oct. 13.—The conclusion of his article (see "Digest" last week). In magnetizing an iron ring whose radial depth is not very small the distribution of the induction through the cross-section is not uniform, as the lengths of the magnetic paths, and therefore the permeability, are different; he gives some curves illustrating this for two cases. The determination of the hysteresis losses with flat voltage curves showed nearly the same coefficient as with sine curves, while the pointed curves, always for the same maximum induction or equal area of the voltage curve, gave lower hysteresis losses than in the above two cases; that for the same effective voltage the pointed curves are better is well known. To simplify the calculation of the area of the hysteresis curve the following formula is often used—namely, that the hysteresis energy is equal to the coercive force multiplied by the maximum induction and divided by 3.1416; he gives a table showing that for inductions between 5000 and 12,000 this can be used as an approximate method, but for smaller or greater inductions the differences are quite great. In some new forms of alternating-current and rotary-current generators in which both windings are stationary, the voltage is not induced by the change from the maximum positive induction to the maximum negative, but by a change of induction between two positive inductions; this case he discusses and shows that the same magnetizing force corresponds to a much smaller induction than half of the maximum induction for a complete cyclic magnetization; the iron is therefore not utilized nearly as rationally; the values of the hysteresis coefficient are given, and it is shown that they are all higher than those for a full, complete cyclic magnetization; the hysteresis losses for the same induction are appreciably greater than for a full cycle, and the Steinmetz law is then quite incorrect, as the coefficient has not only quite different values, but is not at all constant. The calculation of the hysteresis coefficient for rotating magnetization is discussed in connection with the iron losses of a continuous-current armature; the Steinmetz law cannot be applied for such rotating hysteresis; the hysteresis per cycle in these cases becomes lower again after a certain high induc-

tion. He then discusses the deduction of what he calls the rotary hysteresis from the linear (see "Digest" last week); rotary magnetization may be assumed to be made up of two perpendicular linear magnetizations. He gives a table showing the Foucault current energy in percentage of the total magnetization energy for different thicknesses of the sheet iron, as determined from experiments; in the same way the Foucault currents in the copper conductors of a dynamo may be calculated, as he shows.

REPRESENTING MAGNETIC QUALITIES OF IRON. Kath. "L'Eclairage Elec.," Oct. 8.—A translation in abstract of the article noticed in the "Digest" July 16, in which he proposes a uniform method for representing such qualities.

CONSTANCY OF RESISTANCE STANDARDS OF MANGANIN. Jager and Lindeck. "Elek. Zeit.," Oct. 13; an abstract of a contribution from the Reichsanstalt, published in the "Zeit. f. Instrumentenkunde," 18, p. 97.—An article on the investigation of the manganin resistances of that institution. The investigations extended over a period of more than five years, and show that the constancy of the manganin resistances, whose temperature coefficient is very small, is even better than was expected, and in this respect exceeded the mercury copies of the resistance. The wire and band resistances during this period changed only by a few hundred thousandths; within this limit, therefore, manganin resistances which have once been determined can be depended upon for that period of years. Formerly bands 35 mm in width and 0.1 mm in thickness were used for resistances of 0.01 ohm, but now the bands are made 1 mm thick, 10 mm in width and of a corresponding length. The small resistances have also been very satisfactory, the largest change in six resistances of 0.1, 0.01 and 0.001 ohm was only a little more than 0.01 per cent. in 2.5 years. The institution is now ready to guarantee the calibration of manganin resistances to the following accuracy: From 1 to 10 ohms, 0.01 per cent.; 100, 1000, 0.1 and 0.01 ohm, 0.015 per cent.: 10,000 and 0.001 ohm, 0.02 per cent., and 0.0001 ohm, 0.03 per cent.

E. M. F. OF STANDARD CELLS. Taylor. "Phys. Rev.," Sept.-Oct.—A long description of investigations undertaken some years ago to determine the e. m. f. of the cadmium cell as compared with the Clark; he also endeavored to find whether the e. m. f. of the cadmium cell is invariable when the cell is made by different individuals and with materials from various sources; about twenty cells of each kind were made. For the current measurements a newly constructed electro-dynamometer, which is described, was used, but it seems that the absolute determinations are not reliable; he claims, however, that there is no reason to doubt the correctness of the relative values; for the ratio of the Clark at 15° to the cadmium at 21.7° C. the ratio was 1.4077; the value of this ratio obtained by Jaeger and Wachsmuth, with the cadmium cell at 20°, was 1.4063. He found no more difficulty in constructing cadmium than Clark cells; their e. m. f. is as uniform as with the best Clark cells.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY.—Lond. "Elec.," Oct. 14.—A report of the meeting of the company owning the patents. The leading editorial is devoted to this subject; a number of illustrations are given in which the system could be applied to advantage, as, for instance, to and from or between ships; it is thought that there is a good field for the use of such methods.

GUTTA PERCHA. Combanaire. "L'Elec.," Oct. 15.—An article on "the coming disappearance of submarine cables," in which he discusses the question of the supply of gutta percha.

MOTOR GENERATORS FOR FIRE-ALARM CIRCUITS.—"West. Elec.," Oct. 22.—A brief description of the small motor generators used in connection with a storage battery in that plant.

COAST SIGNAL SERVICE IN WARTIME.—"West. Elec.," Oct. 22.—A brief description of the recent service, from the New York "Tribune."

ELECTRIC BALLOON SIGNALING. Bruce. "Elec Eng.," Oct. 20.—A reprint of the Brit. Assn. paper noticed in the "Digest" Oct. 22.

Miscellaneous.

MANUFACTURING WORKS.—Lond. "Engineering," Oct. 14.—The beginning of an illustrated description of the works of the Elektricitaets-Actiengesellschaft at Nuernberg, Germany, which was formerly known as the Schuckert Company, founded by the late Schuckert. The illustrations include interior and external views, besides some illustrations of some of the machines. This is one of the largest electrical manufacturing companies in Germany.

CARBONS. Jehl. Lond. "Elec.," Oct. 14.—In this continuation of his long serial he gives hints to carbon manufacturers and electric light engineers. The testing room of a carbon factory and the methods of making the tests are described.

ALUMINUM FURNACE.—Lond. "Elec. Rev.," Oct. 14.—An abstract of Goldschmidt's article noticed in the "Digest" May 28, in which he describes the furnace in which aluminum is used as fuel.

BRITISH ASSOCIATION.—Lond. 'Elec.," Oct. 9 and 14.—A number of communications in reply to the criticism of that journal noticed in the "Digest" Oct. 15.

ACTION OF ELECTRICITY ON PLANTS. Cooke. "Elec. Eng.," Oct. 20.—A reprint of an abstract of the paper noticed in the "Digest" Oct. 22.

An Improved Dynamo for Three-Wire Circuits.

Up to a few years ago the three-wire system was employed in all large isolated plants and small low-tension stations by reason of the large saving in copper over the two-wire system. It was found, however, that where the all-day load was less than the capacity of two of the standard units employed, the losses in operating the small or lightly loaded machines offset the saving in copper at full load. Therefore, in most plants recently installed the simple two-wire system has been adopted, and many small stations are now using this system with 250-volt lamps, although the higher price of such lamps and their lower efficiency largely offsets the saving in copper.

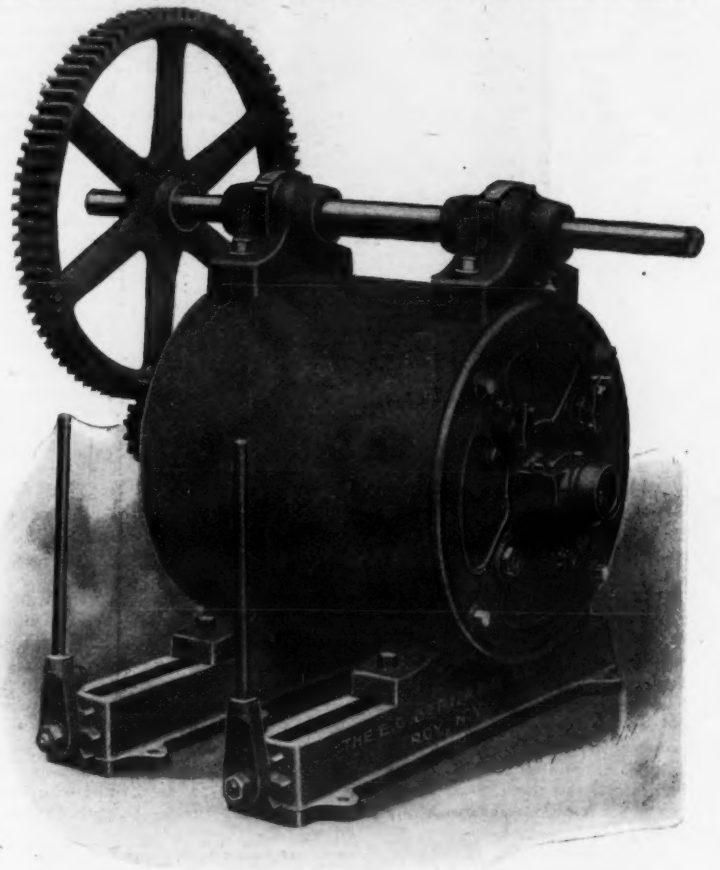
Several methods have been devised for supplying a three-wire system from a single machine, with small motor-generators to balance the system, a few machines having been built with double armature windings and two commutators. All of these methods, however, have been more or less complicated, and none will operate when the system is considerably out of balance.

There has lately been placed on the market a machine that, it is claimed, will supply a three-wire system and maintain the voltage with any distribution of load. It is of the usual multipolar construction, with single armature winding, single commutator, etc. It differs from ordinary machines only in the manner of exciting the fields, which is a modification of the multi-circuit system developed by Mr. Rushmore in his multi-voltage dynamos, motor dynamos and multi-circuit arc machine, and described on page 183 of THE ELECTRICAL WORLD of February 5, 1898.

There is now running at the Rushmore works in Jersey City a 30-kw machine supplying a three-wire system, that fulfills all the conditions of two 110-volt machines in series. It will deliver its entire output at 220 volts, or at 110 volts, and one side may be loaded to 75 per cent. of the total kilowatt capacity of the machine without loss in efficiency and without interference with the other side, which may or may not be loaded. The brushes are fixed, and there is no sparking with any distribution of load. One side of the system may be kept constant at any voltage, and the other raised or lowered to any extent without the least interference.

Inclosed Motors and Generators.

The E. G. Bernard Company, Troy, N. Y., is manufacturing and installing inclosed apparatus of the barrel type, an example of which is shown in the accompanying illustration. The various improved details, excellence of workmanship and high grade of material have resulted in the production of machines which are claimed to be unsurpassed. They are especially adapted for direct connection to shafting, machinery, elevators, pumps, exhaust fans, etc., and for use in all places where moisture exists or economy of space is desired.



INCLOSED MULTIPOLAR MOTOR, BACK GEARED.

They are built for all voltages and speeds, and are claimed to be unequaled for launch or steamer lighting, when direct connected to vertical high-speed engines. A recent installation was made at Dobler's brewery, Albany, N. Y. Two 5-hp motors were placed in a very wet racking and cleaning room; one fastened on the ceiling and belted to the washer, the other on a post and geared with sprocket wheel to the keg hoist. One motor of 5 horse-power is direct connected to a beer pump and placed in the refrigerating cellar; one of 3 horse-power is placed in the open air, for operating washing machines, and one of 15 horse-power is direct connected to a Graves elevator. In addition to these there are two direct-connected generating units, one of 16 kilowatts and the other of 35 kilowatts.

A New Circuit Breaker.

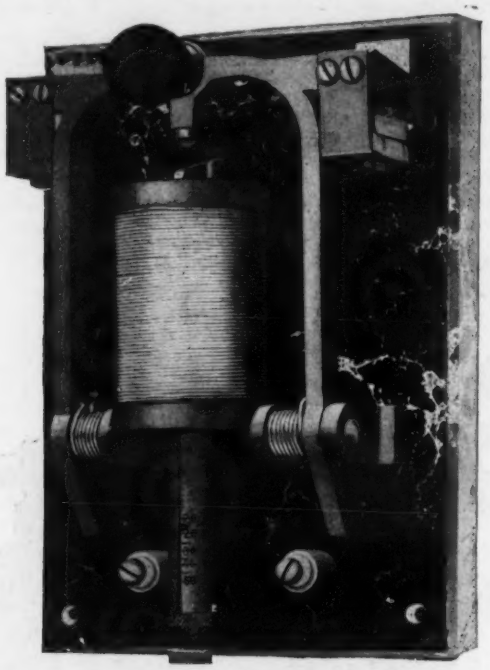
The cut shown herewith illustrates a new type of single-pole circuit breaker manufactured by F. A. La Roche & Co., Thirteenth and Hudson Streets, New York City.

This circuit breaker is also made with overload and undervoltage attachments for motor work. It is especially adapted for high voltages, ranging in the neighborhood of 2000 volts, and is guaranteed to break 2000 volts successfully without arcing at the clips.

This feature is accomplished by the method of attaching the carbons to the breaker. It will be noticed that the carbons are parallel to the clips, and as the breaker opens the carbons attached to the blades open with a cam motion, which keeps a rubbing contact on the stationary carbon until the blades themselves are well out of the clips and at a safe distance; then the circuit is finally broken through the carbons and below the clips, so that no burning of the clips or blades can possibly take place. The blades are of the wedge type and close into V-shaped lips. These are laminated and flexible to an extent, so that they adapt themselves to the shape of the blades, and an absolutely tight contact is thereby formed.

The latch and trigger are made of case-hardened steel, and are of the compound-lever type, so constructed as to permit the use of a very weak solenoid, as the force of the blow required to operate the breaker will be very small. This method of construction is new in this style of instrument.

The hinge posts and blade arms do not carry any current. There are two phosphor-bronze springs in each hinge. These springs are quite weak, and only sufficiently strong to give the switch a sharp and quick break. Owing to the peculiarly shaped blades and clips it is an absolute impossibility for the circuit breaker to stick, the construction of the clips tending to throw the blades out. This breaker would really operate without these springs in the hinge, which are placed there only to assist in quickening the motion.



Improved Circuit Breaker.

On the bottom of the lever arms are two projections, which are parts of the blade frame, and come in contact with a buffer, so that when the breaker is opened and performing its function the blow on the hinge post is reduced to a minimum.

Underneath the solenoid is a copper tube upon which is marked the calibration in amperes and fractions thereof. Upon the end of this tube is a milled head screw and nut, which permits of adjusting the circuit breaker to open at any desired point within its guaranteed high and low ampere ratings.

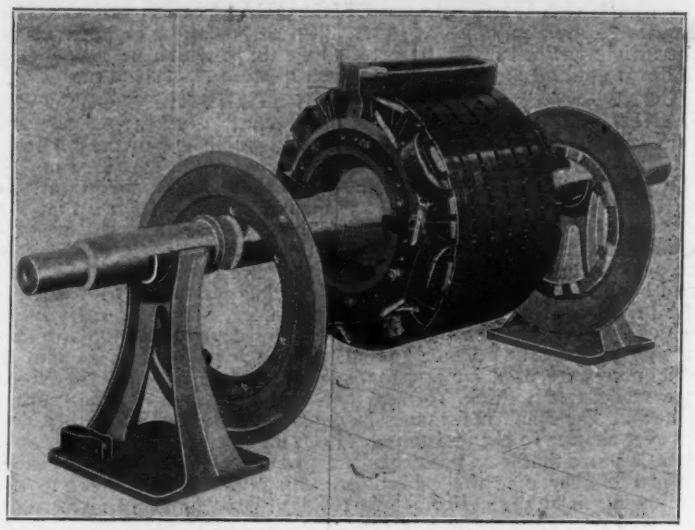
These circuit breakers are handsomely finished in copper throughout, no brass or iron being used. They are among the neatest and most substantial circuit breakers on the market for motor work, and will perform their duty satisfactorily under the most trying circumstances, without failure to operate. They are mounted on either white marble or marbleized slate bases, as may be desired, and require no remounting. As each breaker is provided with binding posts it will operate in a box or panel board, requiring a depth of only 5 inches.

Special care is taken in calibrating these instruments, and they are said to be as reliable as any standard amperemeter. They are made in sizes from 15 amperes up to 500 amperes. Above the latter size the manufacturer recommends the "Victor" No. 1 circuit breaker or the "Ideal" circuit breaker, both of which are manufactured by the same firm.

Sixty and One Hundred and Twenty-five-Cycle Single-Phase Alternators.

For alternating-current electric plants with a high potential distribution, in which lights form the whole load, a high periodicity is desirable owing to the low first cost of such generators and transformers. When, however, long-distance transmission enters as an important factor, a periodicity of sixty cycles, on account of the diminished reactive drop it gives in the lines, allows of transmission over a greater distance than does a high periodicity.

The General Electric Company manufactures alternators with a frequency of 60 or 125 cycles in both revolving-armature and revolving-field types. Revolving-armature machines of 125 cycles are built in five standard sizes, 30, 60, 90, 120 and 180 kilowatts, each size wound for 1040 or 2080 volts. The low-periodicity alternators are wound for 1040, 2080 or 3120 volts, and are built in capacities of 60, 90, 120 and 180 kilowatts. All are arranged for belt driving, and are set on slides.

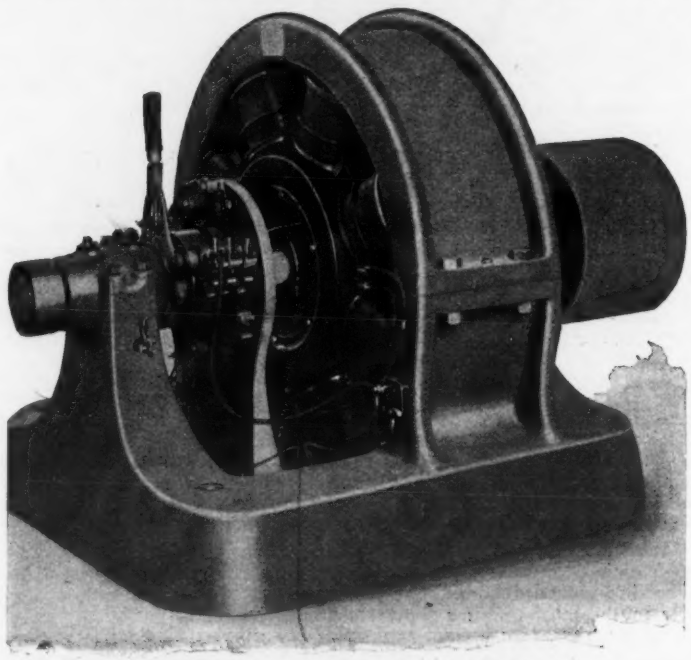


Armature of 60-Cycle Alternator.

As has been proven desirable by many years of successful service, the fields are composite wound, part of the main alternating current being rectified for the series excitation. The current for the separate excitation of the fields may be derived from any constant-potential direct-current source, commonly a small exciter, driven by belt from a pulley on the end of the armature shaft. The two windings allow the adjustment of the fields to automatically compound with change of load, giving at the terminals either a constant potential or a rising pressure to compensate for line loss.

The external field yoke is a cast-steel ring flanged outwardly for stiffness and fitted with inwardly projecting poles of laminated iron. The armature is unitooth, with the same number of coils as poles, the soft-steel laminations being japanned, while to guard further against eddy currents thin paper sheets are interposed between adjoining plates at frequent intervals. The form-wound coils are secured in the parallel-sided slots by insulating blocks and binding wire. They are protected at their ends by rings of light metal. This method allows the ready removal of any coil when necessary.

The rectifying commutator and the collector rings are underhung on a separate metal hub keyed to the shaft. The collector brush holders are supported on a cast-iron standard from the base, and insulated from it by hard-



Single Phase 90-kw Alternator, 60 Cycles.

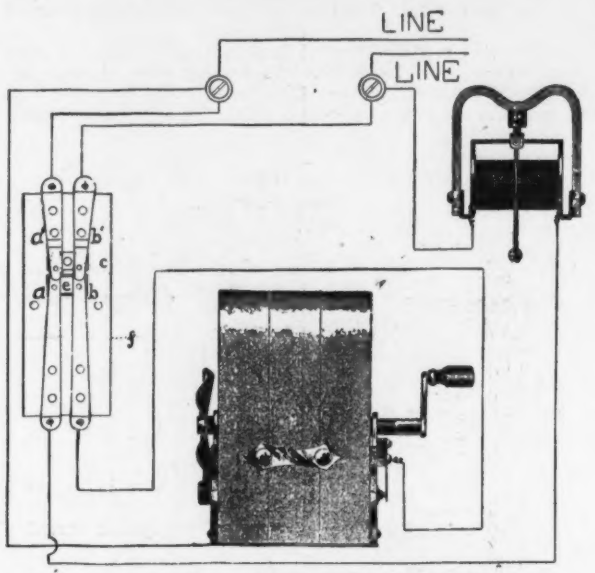
rubber bushings. The commutator brush holders are supported on a yoke carried by the adjoining pillow block. The bearings are spherical, self-oiling, self-centring and self-aligning, and of ample length to insure cool running.

Each alternator, before shipment, is subjected to a most thorough test. The insulation of the separately excited field coils is tested at 3000 volts alternating, and the series coils and armatures at pressures at least double the normal operating voltage.

New Non-Infringing Multiple Toll-Line System.

The accompanying illustration shows a new and unique way of connecting in multiple telephones on a toll or party line. It is claimed by the manufacturer, the Williams Electric Company, Cleveland, Ohio, that it is more efficient than the Carty bridging system, and absolutely non-infringing. The company has applied for letters patent on this system.

The principle of the system, as will be seen from the illustration, is to connect the generator and ringer of every instrument in series with one another, while the different instruments are bridged across the line in multiple. This is accomplished by means of a double-acting double-circuit push button, where *f* is a fibre or hard-rubber block, which has riveted to it contact springs *a* and *b*, *a'* and *b'*, which connect to the terminals of the ringer and generator and to the two line wires, respectively. There is also a contact plate *c* upon which contact springs *a* and *b* normally press, thus short circuiting them or connecting together the free terminals of the generator and ringer. The other terminals of the generator and ringer are connected to the opposite line wires, respectively. To operate the bell in sending a call a button (not shown in illustration) is pressed, which removes contact springs *a* and *b* from contact plate *c*, and connects them respectively to contact springs *a'* and *b'*, thus communicating directly with the opposite line wires. This operation throws the ringer and



RINGING CIRCUIT OF MULTIPLE TOLL-LINE SYSTEM.

generator, while in the act of sending a call, into direct multiple connection with the line wires, so that the current impulses from the generator are not weakened or retarded by having to ring through resistance coils, but on the contrary are delivered to line in their full strength. The ringers are high wound and the generators are low wound, and the added self-induction and resistance of the generator coil—the latter being in series with the ringer coil—have the effect of making the self-inductance and resistance of each station or instrument that is bridged across the line considerably more than would be the case were they bridged directly to line under all conditions, as in the Carty system. This being the case, the ringing current will have a tendency to divide more equally along the line, thus giving better service than by the old method. The advantage of this system is especially noticeable on long lines of iron wire where the resistance, leakage and static capacity all combine to the detriment of good service. The ringers are wound to a resistance of 1000, 1600 or 2500 ohms, as may be specified. The new Williams single-core ringer employed in this system gives to the latter a very high efficiency, inasmuch as its construction gives to it a large coefficient of self-induction.

A New Pump Packing.

A specialty in hydraulic packing is the new one known as Goodsell's "'98." It consists of a high grade of fine pump packing in square form finished by a seam of wax-cord stitching, parallel to the wearing edge, which is intended to successfully prevent the possibility of separation or splitting of the piles of duck

AN IMPROVED FORM OF PACKING.

when in contact with the plunger or cylinder. There has been room for such an addition to the holding qualities of rubber friction as usually provided, and operators of pumping plants will welcome any real improvement in this direction.

This new article is exclusively made by the Goodsell Packing Company, 33 South Canal Street, Chicago, which has installed special machinery for its production, and whose other specialties hold a prominent place in the market.

The Columbia Electric Automobiles.

THE first Columbia electric automobile was placed on the market about a year and a half ago, and was described in THE ELECTRICAL WORLD of May 15, 1897, since which time the Pope Manufacturing Company has been steadily experimenting, developing and improving this line of horseless carriages to such an extent that a further article on the subject is warranted. Many ingenious improvements have been developed by the skilled engineering staff of the company and incorporated in the vehicles, the description and illustrations of which appear below.

Three styles of electric vehicles manufactured by this company are now on the market, one being the single-seated phaeton, designated as Mark III.; one a double-seated carriage, Mark IV., and one a two-seated back-to-back trap, Mark VI. While many interesting features are common to all three vehicles, in each there exist certain special points which are well worth notice.

Mark III. is a form of hooded phaeton intended to seat two persons. The body (see Fig. 1) is mounted on three Brewster springs hung from the side bars of the running frame, which is made of 0.50 carbon steel tubing, graceful in outline and designed to give the greatest resistance to strains with the least weight. These side bars are made up of two tubes braced together by struts at the points of spring support to give a stiff beam and brazed at their ends into the forged corner joints of the frame. The member of the frame running across the front of the vehicle consists also of two tubes arched downwardly, as shown in the initial illustration, supported by a horizontal fore-and-aft swivel, allowing the bow-shaped axle-tree of the front wheels to oscillate in a vertical plane across the carriage to take up any irregularities that the carriage may pass over without straining the frame. This obviously gives a sort of tricycle construction, the frame proper being supported at only three points, and therefore never distorted as must be a frame supported at four points.

Individual wheel steering is used with all these carriages, each end of the axle-tree being brazed into a forked bracket, which affords bearings for a pivot inclined slightly backward from the vertical, and forged in one piece with the wheel spindle and a rearwardly projecting lever arm. The inclination of the pivot causes a tendency to maintain the wheels in a straight-ahead direction, and renders the operation of steering less fatiguing than would otherwise be the case. The rearwardly projecting lever arms are connected by two tubular rods to two arms of a three-armed forging pivoted on ball bearings at the centre of the axle-tree (see Fig. 2), the function of this device being to cause a greater angular movement of the inside wheel in turning, thereby maintaining all four wheels tangent to concentric circles, which is an essential for rolling around a curve that would not be fulfilled were the forward wheels maintained parallel with each other. The third arm is connected through a tubular rod and ball and socket joints to a vertical lever attached to a spiral gear sector meshing, with a corresponding gear keyed to the steering post running up through the middle of the carriage and controlled by the steering handle within easy reach of the driver's hand.

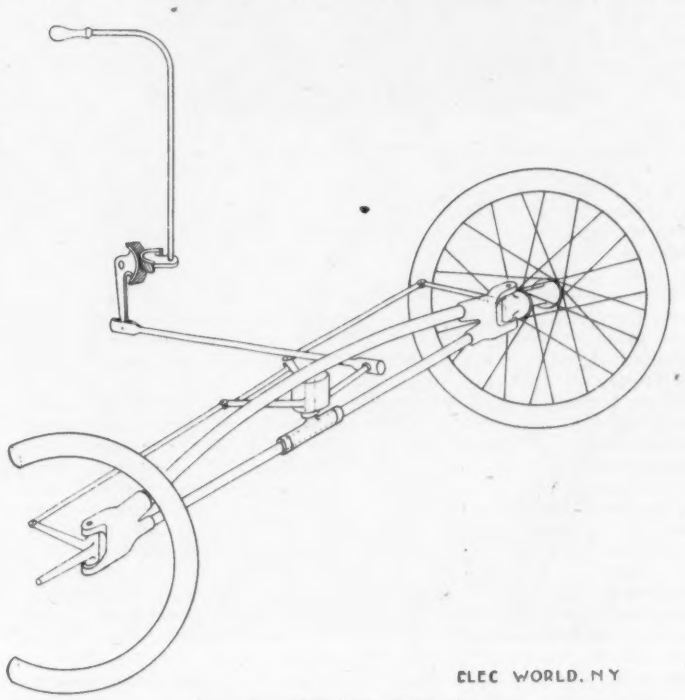


FIG. 2.—THE STEERING GEAR.

The rear member of the frame (see Fig. 1) consists of a single straight tube carrying forged-steel hangers, affording ball-bearing supports for the motor shaft and the driving axle. The two rear driving wheels are axle-driven and mounted on two separate axles, both terminating in the balance gear, by which both wheels are driven with the same force, but one is allowed to turn faster or slower than the other in going around corners. This balance gear is of the ordinary bevel-gear type, with four intermeshing pinions, one on each driv-

ing axle and two on a spindle at right angles to the driving axle and driven by the casing. The casing is supported by ball bearings in the two adjacent hangers, and is driven by a double-reduction gear exactly like the back gear on a lathe, the motor itself being mounted with its hollow armature shaft concentric with the axle of the right-hand wheel. The motor is of special design, intended for the maximum attainable efficiency and capacity, with minimum weight, and specially adapted to heavy overloads. It is a four-polar, series-wound, designed for a normal load of 2 horse-power at 75 volts and 1000 r. p. m., and capable of readily withstanding 100 per cent. overload for half an hour and heavier loads for shorter periods. Operating under normal-load conditions it shows an efficiency of 82 per cent., and maintains almost as high a figure when run at overloads as high as 150 per cent. Its weight is but 127 pounds. The field frame is fastened at each end to hangers from the vehicle frame above, which also provide ball bearings for the hollow armature shaft.

The brake is a very powerful form of the band type, and consists of a cast bronze strip, rigidly fastened to the rear upper tube and encircling the drum which forms the balance gear casing. The band is split diametrically opposite to the rear tube, and by a simple lever connection is clamped about the rotating balance gear drum through the medium of a foot lever located on the floor of the body immediately in front of the operator. Not only is this brake powerful enough to stop the carriage on the steepest hill and to bring it to rest on the level within its own length, but it affords great delicacy in manipulation and absolute control in obtaining any desired rate of retardation. A ratchet and pawl is used in conjunction with this foot lever, giving the operator the means of setting the brake at any desired tension, the release of the pawl being effected by a slight movement of the foot.

The question of storage battery capacity is one of prime importance, but the Pope Company has realized from the outset the necessity of sacrificing nothing in the durability or life of the battery, and, before developing the present type of cell, subjected almost every known variety to an extended and rigid series of tests best adapted to show their ability to withstand the excessively severe and arduous service required in this work. The batteries used in the Columbia carriages are of a particularly light construction, the positive plate being of "Planté" formation, and the negative having its active material efficiently distributed in masses. The carefully studied reduction to a minimum of the weights of the grids and connecting parts and the excellent proportioning of the cell has resulted in a capacity of 3.8 ampere hours per pound of cell, all complete with connecting lugs for carriage use, this capacity being obtained at a discharge rate of 25 amperes or 1.25 amperes per pound of cell complete, as above. The excellent design of this cell and the "Planté" formation of the positive plate admit of a very rapid charge, which, under ordinary conditions, can be completed from empty to full in three hours, if desired. Abnormally heavy discharge rates have no more effect upon this cell than has rapid charging, and hills requiring an average expenditure of 70 or 80 amperes for several minutes and 100 amperes or more for shorter periods have been habitually climbed without the slightest ill effect upon batteries of this type which have been in constant daily use for eight months. The construction of a high capacity cell is not a difficult matter, but such a cell is useless for motor carriage service unless also possessing the unusual characteristics of life and durability, and the makers of the Columbia carriages confidently assert that while the capacity of their battery may be equalled or even surpassed by those of makers of other automobiles, in none of these seemingly high-capacity cells can equal reliance be placed upon their continued good performance, long life and absence from breakdowns.

The complete carriage battery consists of forty-four cells assembled in four separate boxes of eleven cells each. These four boxes can be connected in multiple, two in multiple and two in series, or all four in series, by means of the controller, thereby obtaining the three speeds, 3, 6 and 12.25 miles per hour on the level, respectively, without the necessity of wasteful resistance. The controller lever is unobtrusively placed at the left of the operator, and acts directly through one set of gears on the cylindrical controller placed beneath the seat. On the drum corresponding to the three speeds are three series of contacts, which are brought successively against stationary fingers, giving the circuit changes shown in Fig. 3.

The minor electrical features have been carefully worked out with a view to completeness, simplicity and absolute safety in the most experienced hands. To charge the batteries a flexible conducting cable terminating in two plugs of different diameters is used. These plugs fit into corresponding receptacles at the rear of the carriage, and in no way can a mistake be made in inserting them, owing to the difference in size. The number of cells used makes it possible to charge from an ordinary 110-volt circuit with the interposition of a small resistance at the beginning of the charge.

In the battery circuit is a peculiar form of Thomson recording wattmeter, which registers the watt hours of discharge by a movement of the pointer in one direction, while the charge is recorded by an opposite movement of the pointer, each scale division on the return movement, however, corresponding to a sufficiently increased number of watt hours to adequately provide for the average internal loss in the batteries, so that when the zero or full position of the scale is reached on charge the batteries are again in a fully charged condition. An automatic cut-out operates in conjunction with the wattmeter, and provides against overcharging or waste of power, as well as diminishing the attention necessary to the operation of charging. The action of this cut-out is dependent upon the arrival of the wattmeter pointer at the full position where a contact is made controlling the circuit of the cut-out magnet.

A small plug emergency switch is placed conveniently at the left of the operator, which permits of the breaking of the main circuit at will and can be used in case of accident to the motor or controller. Its extraction also renders the carriage inoperative by anyone not possessing a similar plug should the driver desire to leave it standing unwatched in the street. The electrical connections throughout necessary for manipulation are made by means of plugs and sockets of two different sizes—one for negative and the other for positive terminals—thus reducing the possibility of short circuits to a minimum.

Two side electric lights are provided, as well as a powerful parabolic headlight, all utilizing electric current from the main battery. In addition, there is provided a small protected search lamp, with a long flexible cord attached, admitting of its use at any part of the carriage. These are controlled by switches within reach of the operator. An effective signal bell of pleasing sound is controlled by a push-button in the controller handle.

The tires on this and all Columbia carriages are a special pneumatic cushion type 3 inches in diameter, in which the strength and durability of the cushion tire has been combined with the manifest advantages of the pneumatic. The best air pressure at which these tires can be run is from 100 to 120 pounds; pressures as low as 40 pounds, readily obtainable with the crudest form of hand pump, are practical without injury to the tires or rims, but not recommended, as abnormally flabby tires cause an increase in current consumption and are not conducive to the efficient operation of the carriage. Wherever possible ball bearings have been used, so that not only are the wheels, motor and countershaft journaled in this way, but such bearings have been introduced in the steering connections and controller with beneficial effect.

Much care has been given to the design of a wheel which should combine lightness and rigidity as well as neatness in appearance. The rear or driving wheels have steel rims, hot rolled, fitted and tangent spokes, and are 36 inches in diameter. The forward wheels are 32 inches in diameter and of similar construction.

The Mark III. carriage is capable of a mileage of 35 miles over ordinary suburban roads, the current consumption on a hard level road being approximately 21 amperes. It will climb grades of 12 and 15 per cent. readily, although it may be seen, from the fact that the current consumption on a 12 per cent. grade is in the neighborhood of 85 amperes, that hill climbing carried to an excess will materially reduce the capacity of the batteries and consequently the mileage of the carriage. The total weight of the carriage complete is 2000 pounds.

The double-seated carriage, Mark IV., differs considerably in some of its mechanical features from Mark III. The running frame is made up of two straight side tubes diverging toward the rear, where they are brazed into forged joints fastened to the rear axle, which forms the rear member of the

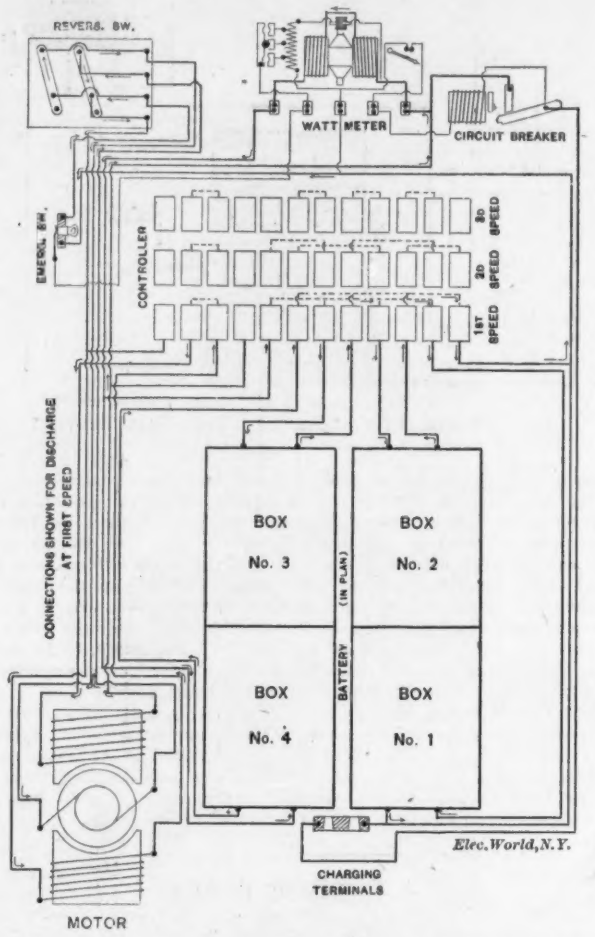


FIG. 3.—THE CONTROLLER CONNECTIONS OF MARK III.

frame. (See Fig. 4.),This axle is stationary, and does not act as a driving shaft, The forward member of this frame is a transverse tube arched slightly to the rear and equipped with the same method of pivot support as in the case of Mark III. Two transverse tubular struts, together with a central longitudinal piece of tubing binding the rear strut to the rear axle, complete the running frame. Substantially the same arrangement of individual steering and wheel support is employed here as with the carriage previously described. Instead of a mechanical balance gear, however, an electrical balance between the two driving wheels is maintained by two motors mechanically separate, but with armatures series connected, each independently geared to its own driving wheel through a single reduction, with annular gears fastened to the hubs of the driving wheels.

Each of these motors is of 2 horse-power capacity, wound for 36 volts at 1000 r. p. m. and is capable of standing the same severe overloads as the Mark III. motor. Since they are connected in series the same torque is developed in each, and so long as there is no tendency for one wheel to move faster than the other there is an equal division of the total applied voltage from the batteries between the two motors, and the speed is the same. In turning curves, however, the inside wheel slows down and the voltage of its motor is lower and that of the other correspondingly raised, resulting in the proper increase in speed of the outside driving wheel.

The brake is foot operated, with the essential characteristics of the one above described, save for the fact that the pressure is divided through an equalizing lever between two small drums mounted respectively upon the armature shafts of the two motors.

The suspension of the body is through two fore-and-aft half-elliptic springs, supported directly upon the rear axle, and one similar transverse spring having its support directly over the front horizontal pivot on the front tube of the running frame. The eye-bolts of these springs are fastened to strong forgings bolted to the underside of the body. The construction of the wheels, tires, steering gear and electric controller is similar to that adopted in Mark III. so far as the essential features are concerned.

The same charging equipment, including wattmeter and automatic cut-out, is used, with the addition of a combined voltmeter and ammeter placed upon the dashboard under the immediate inspection of the operator. This is a special instrument with a high and low voltage scale, the high scale being that ordinarily used, and showing the voltage of the batteries at all times, whether under charge or discharge, the low scale being valuable when investigating the condition of individual cells. The ammeter scale is double reading, having its zero at the centre of the scale, permitting its use during the discharge when upon the road, as well as when the carriage is at rest and the batteries charging with the current in the other direction.

The battery employed is of the same type, but larger and more powerful than that of Mark III. The weight of the individual cell all complete for carriage use is 32.5 pounds, and it yields 129 ampere hours at a discharge rate of 40 amperes, which admits of a mileage of 35 miles over fair suburban roads. These cells are arranged in six groups of seven cells each—a total of 42 cells—two of

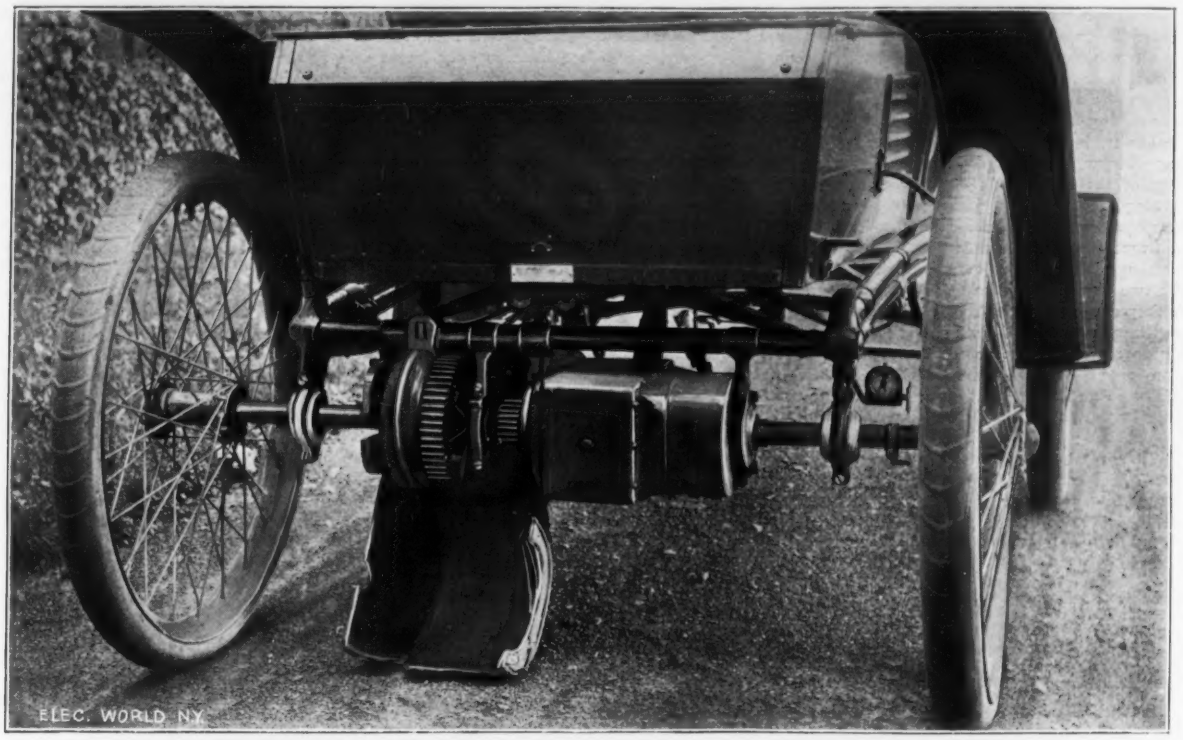


FIG. 1.—REAR VIEW OF MARK III.

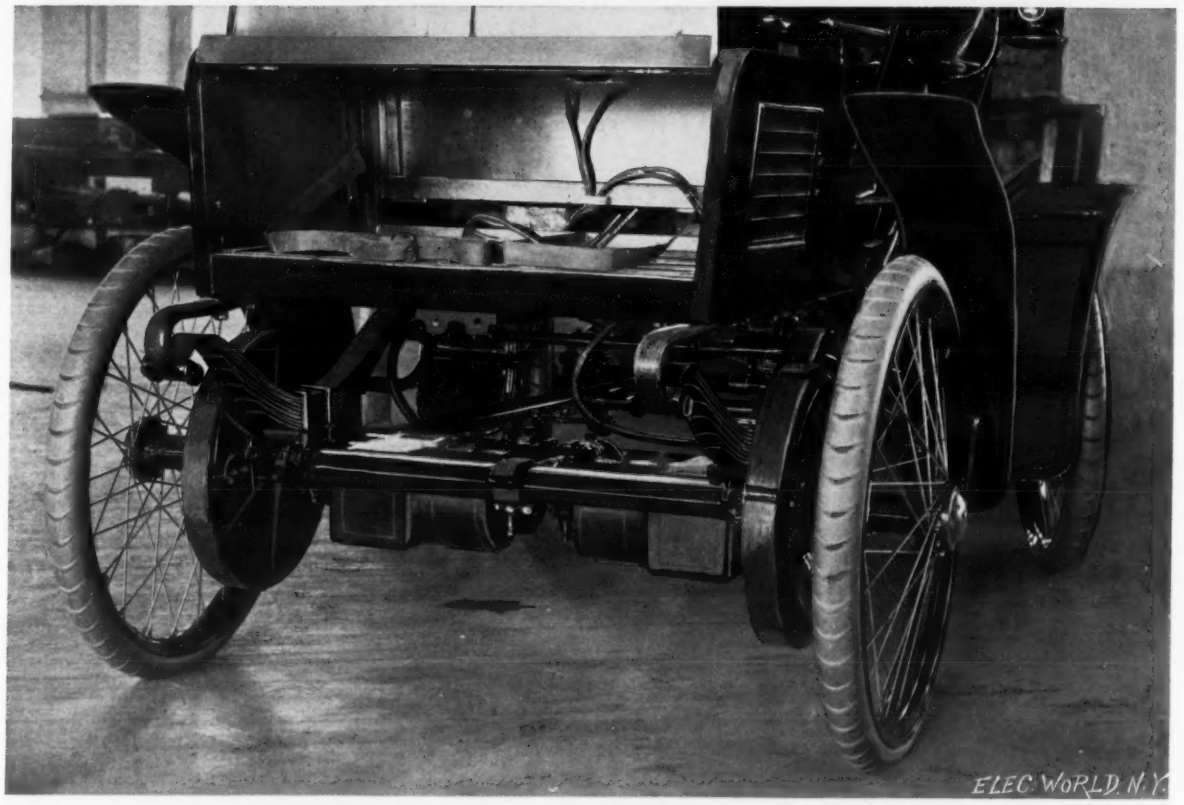


FIG. 4.—MARK IV., FROM THE REAR.

which groups are placed under the forward seat and four under the rear. The controller admits of four combinations of connections resulting in the following speeds:

3	miles	per	hour.	2	groups	in	series.	3	groups	in	multiple.	Fields in series.
6	"	"	"	3	"	"	"	2	"	"	"	" " "
11	"	"	"	6	"	"	"					" " "
13	"	"	"	6	"	"	"					Fields in multiple

The total weight of the vehicle fully equipped with batteries is 3100 pounds.

The third and latest type of carriage, Mark VI., the back-to-back trap, exhibits several points remarkable for their novelty and radical departure from previous methods. It may be said to have no running frame, being mounted, through the medium of four elliptical fore-and-aft springs, directly upon separate front and rear frames, capable of being independently removed and having no connection with one another save through the body itself. (See Fig. 5.)

The most interesting feature in the construction of this carriage from a mechanical standpoint is the method of mounting the motor and the transmission gearing From the method of suspending the body, it will be seen that the driving of the body and forward springs is done through the two rear springs, giving great simplicity in construction and such an independence of the other carriage working parts as to make it perfectly feasible to remove the entire rear frame with its attached mechanism and apply the same to any other form of body desired. Projecting from the lower rear corner of the motor frame are two lugs recessed to fit the square rear axle-tree and fitted with caps by which they are securely bolted to the same, placing the motor in such a position that the centre line of its armature is parallel to, but above and in front of, the rear axle. Each rear wheel is driven through a small pinion meshing with an internal gear fast to the wheel hub. The right driving-pinion shaft has its outward bearing in a bracket extending from the rear axle just inside of the driving gear. From here it passes through the hollow armature shaft of the motor with ample clearance, and also through the balance gear, which is located to the left of the centre line of the carriage and is driven through its casing by means of a dog threaded on the left-hand end of the armature shaft, which projects for several inches outside of the motor housing. The left-hand driving shaft has an outward bearing similar to the right-hand, and bears a like relation to the balance gear, but is made in the form of a hollow sleeve fitted to receive the end of the right driving shaft for a distance of about 8 inches, forming therewith, with respect to mechanical rigidity and strength, a single continuous driving shaft, yet each separate part capable of the frequent but slight relative movement necessary when the carriage deviates from a straight line. The balance gear is built on the principle previously described, but of an improved simpler form, which consists in the substitution of spur in place of bevel gears.

The above-mentioned dog on the armature shaft drives through four fingers which engage the balance gear casing in two diametrical right-angle slots, forming a floating connection similar in principle to "Oldham's coupling," a device which obviates the necessity of alignment in the driving and armature shaft, a condition ordinarily as difficult to maintain in a motor carriage as it is essential. The outside periphery of each internal driving gear forms a brake drum, which is encircled by a split-bronze casting operated in precisely the same way as those of Mark III. and Mark IV.

An interesting feature in connection with the rear-driving wheels lies in the fact that the balls in the bearing are fitted with retaining rings, while the internal gear is bolted directly to the wheel hub, making the entire wheel self-contained and capable of being taken off and replaced in a few moments. The gears are effectually protected from dust and dirt by a flat circular plate covering the exposed interior of the internal gear.

This carriage uses a cell weighing 26 pounds complete, and with a proportionate capacity and a carriage mileage of 35. The total weight of the carriage complete is 2600 pounds, and it requires a current consumption on the level of 25 amperes when carrying four persons.

Each carriage, as soon as mechanically and electrically complete, but before receiving its final finish and upholstery, is subjected to a twofold test. It is first run over obstructions and subjected to repeated strains, which are equal to the severest likely to be received upon the road, and the yielding or alteration of any part is carefully noted by a series of previous and subsequent measurements accurately made. Following the obstruction test, each carriage is given a road run of 20 miles over a specially selected rough, hilly road. This not only forms one of the severest continuous hill-climbing tests which can be made in the vicinity of Hartford, but acts supplementary to the obstruction test in bringing to light structural weaknesses of such a nature as to be more readily affected by the multitude of slight vibratory strains received upon the road than by the sudden heavy shocks occasioned by the obstruction test.

While ability to stand the severest conditions of ordinary road service is perhaps all that might be demanded of any motor carriage, it has been very gratifying to the makers of the Columbia carriages to learn from their behavior in accidents and under abnormal conditions that the factor of safety in the construction of the vital features has been ample. As an example of the strength of the wheels might be mentioned a recent trial of the carriage which took place upon level asphalt to ascertain the efficiency of the steering gear at a high speed. A speed of 14 miles per hour having been reached, it was attempted to turn the carriage sharply around in a 30-foot circle without throwing off the power, and the attempt would have succeeded had not the asphalt been wet and the consequent slippage of the tires too great. The effect was to slide the carriage sideways at full speed until the wheels struck the curb, when it overturned, but without affecting even the alignment of the wheels.

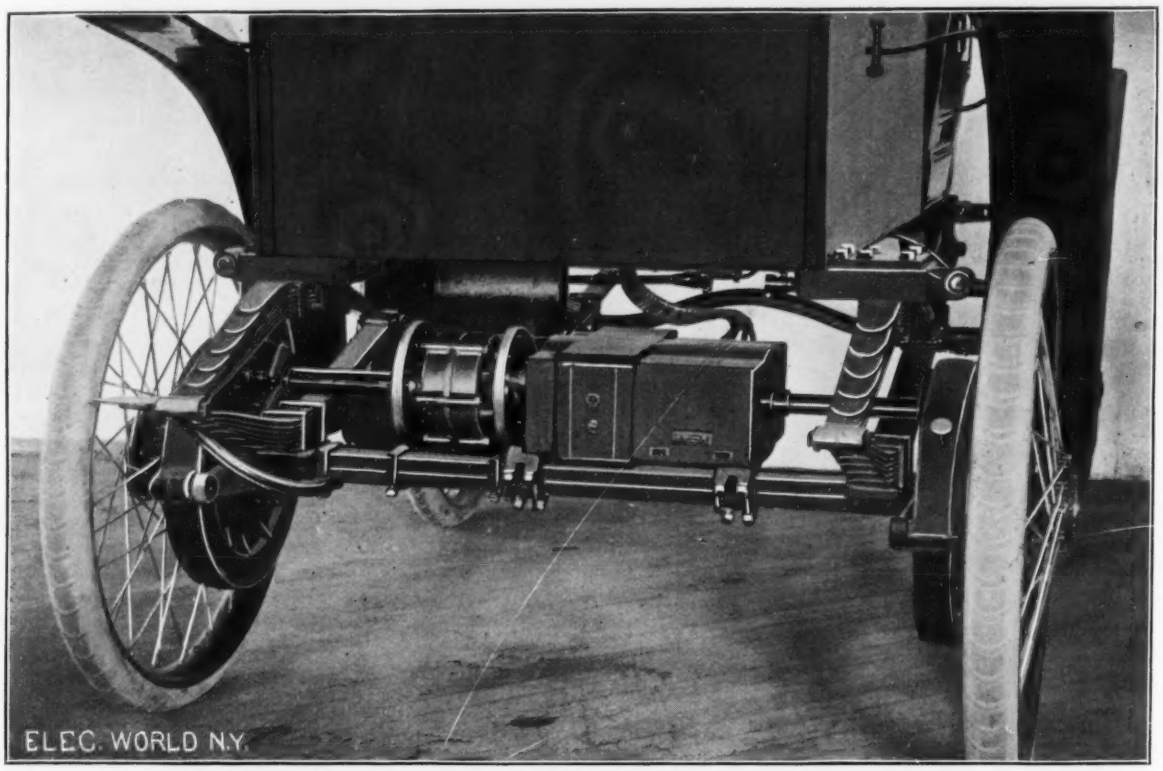


Fig. 5.—The Rear Frame of Mark VI.

It seldom happens where the current is taken from the wires connected with the city mains of central lighting stations that the cost for each full charge exceeds 60 cents, and since lighting and power companies usually base their prices on the amount of current consumed, the user of a carriage employing the same current for lighting his house or any other purpose can arrange to charge his batteries at a cost extremely slight, which cost is still further reduced if the carriage owner possess his own private plant.

Electric Automobiles of the Riker Electric Motor Company.

One of the pioneers in the new field of electric carriage work is Mr. A. L. Riker, who, in the few years that the Riker Electric Motor Company has been in operation has developed a line of vehicles with many admirable and ingenious improvements, some of which are illustrated in the following pages.*

The essential features common to all of these vehicles are as follows: The wheels are built up with metallic hubs, tangent wire spokes, metallic rims and 3-inch pneumatic tires. The running frame is a simple trapezoid made up of the forward and rear axle-trees connected by two tubular steel fore and aft members, swiveled to give flexibility. The carriage body is supported from these by elliptic springs at the rear and reverse elliptics at the front, the latter giving the equivalent of a centre swivel, which reduces the strain on the body in running over irregular surfaces. One four-pole motor of the now well-known Riker type is invariably used with the "wheelbarrow" suspension, as in railway practice, rigidly swiveled to the rear axle-tree and spring supported from the body at the nose, thus getting also the flexibility of the body springs. The motor pinion meshes directly with a gear concentric with the axle-tree, giving the regular single reduction inside an enclosed gear case of railway practice.

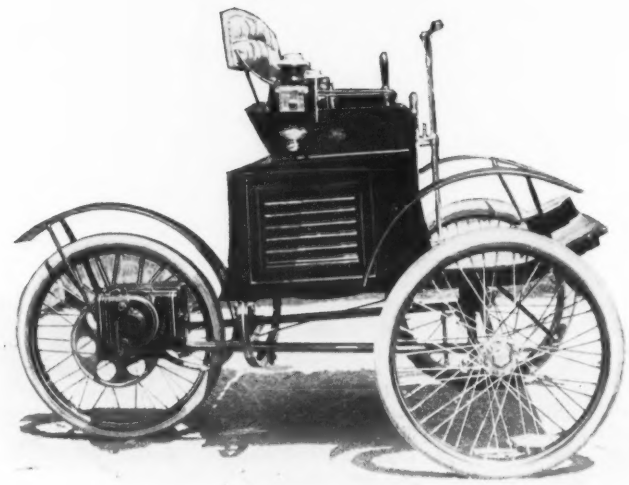
*See also The Electrical World of September 4, 1897.

DELIVERY WAGON.

DOS-À-DOS.

TWO-PASSENGER TRAP.

VICTORIA.



TRICYCLE.

PHAETON.

Some of the Riker Electric Vehicles.

By the side of this main gear and within the same case is a pulley on which acts a band brake, besides which shoe or spoon brakes are also fitted to the rear tires.

The "Jack-in-the-box," differential or compensating gear, to give its various names, is located inside one of the cylindrical hubs, its four intermediate bevel pinions being driven by a sleeve from the main gear meshing with the motor pinion. This gives a solid inner axle clear from this hub to the hub of the other wheel, instead of an axle divided at the compensating gear, as is the case with most other vehicles. Ball bearings are used in the lighter vehicles and roller bearings in the heavier. The steering is effected by the usual hub pivot arrangement, the pivots being placed, however, within the hollow hubs of the forward wheels. These pivots are vertical, and with cone-shaped ends. A proper increased deviation of the inside wheel when turning is obtained by the non-parallelism of the pivot cranks.

Perhaps the most interesting features of these vehicles are the ingenious details of the controlling mechanism. The ordinary cylindrical controller under the seat is used, giving by means of a series-multiple combination of the batteries three speeds forward and two to the rear. In the main circuit is an automatic circuit breaker, which opens in case the motor is given more than 400 per cent. overload. This is reset simply by restoring the controller handle to the off position. On the footboard or dashboard is a combined voltmeter and ammeter, showing at all times the pressure of the cells and the load on the mechanism. An automatic switch in the charging circuit prevents the connection of the batteries with the wrong polarity, and cuts off the batteries when fully charged.

The electric tricycle is rather interesting, as it is one of the lightest vehicles yet developed and weighs only 800 pounds. It has a 4-foot wheel base and a 4-foot tread, with wheels 28 inches in diameter, fitted with 2½-inch pneumatic tires. The motor is rigidly suspended, meshing directly with a gear on the hub of the single rear wheel, the steering being effected by the usual forward hub pivots. The motor is rated at 1 horse-power at 40 volts, and weighs about 60 pounds, the gear ratio being 8 to 1.

The Vehicles of the General Electric Automobile Company.

The types of vehicles of which this company is now completing its first equipments are delivery wagons, physicians' and pleasure phaetons and broughams or coupés.

The electrical equipment upon these several vehicles is substantially the same and is described below. The delivery wagons are provided with a fifth wheel steering gear on the front wheels, controlled by a small hand wheel on horizontal axis and operating through gearing a worm or tangent screw, which works in a worm-gear segment fixed to the pivoted axle. This method of steering delivery wagons is preferred, because by it the axle is always locked, and excessive strains and jars cannot come upon the operator. It is found by experience that this steering gear works most satisfactorily. It furthermore enables the most approved customary type of spring-body support to be employed, which is deemed advisable and especially so for vehicles required to carry heavy loads. The batteries are arranged in trays and placed within a compartment under the rear of the body, and furnished with a spring floor to reduce the jarring upon the battery when traveling over rough roads or crossing railroad tracks. The wheels are fitted with anti-friction bearings, and the rear wheels are independently driven by separate motors. The wheels are of wood, with solid rubber tires. Pneumatic tires will not be used. The accompanying figure shows one of these wagons.

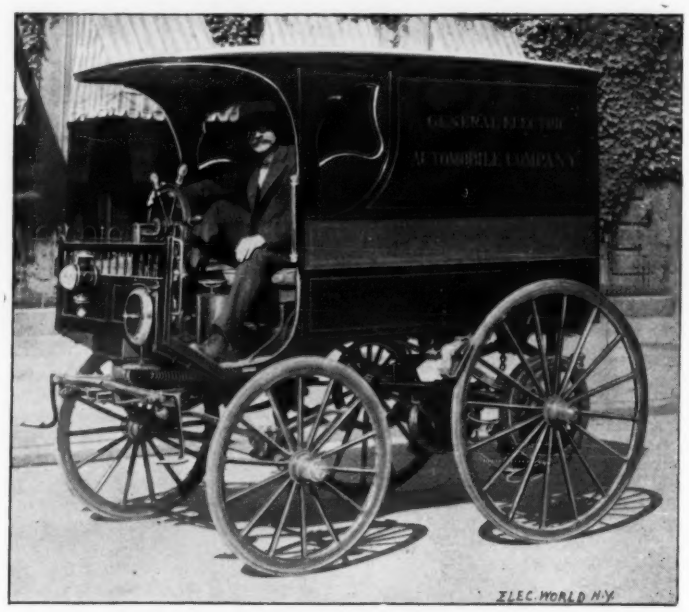
The phaetons for physicians and pleasure riding is in design between a doctor's carriage and a stanhope, consisting of a seat for two persons, with handsome upholstery and cushions side and back. The battery compartment extends under the seat and backward, with a drop-hinged door at the rear. Handsome lamps, both for electric light and candles, are provided on the sides of the body. The running gear consists of two large rear and two smaller front wheels, all of wood, and having solid rubber tires. The front axle-tree is carried upon springs secured to special iron extensions from the body, and the wheels are turned for steering by knuckle joints or side pivots, and moved by a steering lever extending upward through the body near the dasher and leading backward toward the seat. The rear axle is also fixed and carried by a similar set of springs. The wheels are all furnished with ball bearings. These vehicles are designed to give a light-weight effect and rich yet simple design.

The brougham is but very little larger than ordinary types of fine carriages of this class. In general design it does not differ materially from the best styles of Rogers or Brewster makes, with the exception of the front running gear, which is made similar to that of the phaeton, but heavier. In this vehicle the knuckle-jointed axle or individual wheel pivot is preferred instead of the fifth wheel because of lightness, cheapness, quicker steering and improved design. The front wheels are smaller than the rear wheels, as is customary. The axle boxes are provided with roller bearings. The eye is not offended by any abnormal changes in design from that it is accustomed to seeing, the company believing that any radical changes in design should come by degrees to avoid public aversion to riding in objectionably conspicuous vehicles. The motors are located under the rear portion of the body and geared to the large rear wheels. The batteries are placed within a compartment under the floor of the body, but so shielded and worked into the structure of the carriage that it is not perceptible. This result is secured by having a false floor and making the doors fit down over the sides of the battery compartment. The front projection upon which the operator's seat is located is arched in form, just as in the modern brougham, and the controller is placed out of view under the seat. The battery compartment has the bottom hinged to drop at the forward end, and permits the batteries and the trays to be withdrawn or inserted. When in position the bottom is raised and locked in place. The construction makes this vehicle somewhat shorter geared than a horse brougham of the same size.

The electrical equipment of these vehicles consists of the following: There are forty-four cells of battery coupled in such a manner that for all normal work the cells are maintained in series, but for certain work, as in mounting very steep and short grades or starting exceptionally large loads, the cells may be temporarily arranged in two sets, and these put in parallel. The batteries are automatically coupled up with the motor circuits on the vehicle, through the media of contact switches, by simply sliding the trays into the compartments. While the batteries are adapted to be removed from the vehicle for charging, sockets are provided for attachment plugs, so that the batteries may be charged while in place, and these plugs are so constructed that it is impossible to make a wrong connection or reverse the polarity.

The motors are two in number and develop 2 horse-power each on normal running, but may be worked up to twice that power at 800 r. p. m. for a considerable period without excessive heating. They are four-polar, with the armature shaft carried in roller bearings, and operate on eighty volts. The field windings are divided into two coils, so that those of each motor may be thrown in series or multiple. The motors are hinged to the rear axle near the outer ends thereof, and are supported from the vehicle body. The armature shafts extend close to the wheels, and are fitted with pinions of 3½-inch diameter, working on annular gears of 22-inch diameter, fastened to the spoke arms. The gears are of phosphor bronze and carefully cut. The ratio is 1 to 6.28.

The controller is placed under the floor in the phaetons, and under the operator's seat on the box in the broughams, and is operated by a hand lever. It is of the series-multiple type, adapted to give four speeds and one brake position. The first notch puts the two motors in series with the field-magnet coils also in series. The second notch maintains the armatures in series, but with the two sets of field coils of each motor in multiple. The third notch throws the two motors in parallel, but connects the two field coils of each motor in series. The fourth notch maintains the motors in parallel, but also throws the two field coils of each motor in parallel. The brake is set by moving the controller lever the other way, and throws the fields and armatures all in series on a short circuit, causing the machines to act as braking dynamos. This is only resorted to in case of emergency or in descending steep grades. A foot brake is provided when desired for ordinary uses. In all of the working notches, one to four, of the controller the batteries are connected with all of the cells in series, giving a maximum voltage of 88. On the fourth or parallel notch the speed is 19.8 miles per hour. In addition to the series-multiple controller there is an electric switch for throwing the battery cells in two series of 22 cells each and these two in parallel with each other; and this is employed in connection with the parallel arrangement of the motors, namely, the third and fourth notches when the internal resistance and counter e. m. f. is lowest. This connection is only used in starting heavy loads or climbing steep grades.



General Electric Automobile Company Delivery Wagon.

In addition to these switches for controlling the speed and braking there is a separate hand-controlled switch to reverse the armature connections for running backward. In the phaeton these various switches and the controller lever are arranged at the left-hand side of the seat and extend up through the side rail and in convenient reach. This enables the operator to sit on the side adjacent to the middle of the road and to see more clearly for steering and avoiding collision with passing vehicles.

The General Electric Automobile Company is now arranging plans with a view of extensively introducing electric delivery wagons into the business of the large Philadelphia stores in place of the hundreds of wagons now moved by horses. It also proposes to establish carriage and cab vehicles for hire in all of the large cities, and otherwise extend this coming mode of transportation. The company also intends in the near future to build all of its own motors as well as batteries, so as to be wholly independent.

The company has its headquarters in the Bourse at Philadelphia, and was organized by Mr. Rudolph M. Hunter in the early summer of 1898, the basic patents being those covering his inventions in this line. The officers of the company are: Prof. Wm. D. Marks (until recently president of the Edison Electric Light Company, Philadelphia), president; John H. Noblit, vice-president; Aubrey B. Pearson, secretary and treasurer. These gentlemen, with Col. Clement W. Cox and Rudolph M. Hunter, constitute the directors.

The company is just completing arrangements for suitable buildings and machinery for manufacturing its own batteries, with a view of reducing the cost, and so as not to be dependent upon any outside concern for this essential part of its equipments. The buildings will also have ample storage room for vehicles. It further proposes to introduce small isolated charging stations at various places over the city for the convenience of its patrons.

The "Petite" Enclosed Arc Lamps.

The Western Electric Company, Chicago, has recently placed upon the market a line of enclosed arc lamps of particularly handsome design.

The incandescent lamp for a long time held undisputed sway in the field of decorative illumination, but the enclosed arc lamp has become a strong rival in this department through its adaptability to decorative application. In its development it is growing shorter in length, which is an added feature of importance when contemplated from a decorative standpoint.

The "Petite" lamp, which is the subject of this article, is of very small proportions, and can be used in rooms having low ceilings. The direct carbon feed is adopted, and as a consequence the number of working parts are reduced to a minimum.

A novel feature of design is found in the lamp frame. The current, which is fed from the upper carbons to the lower carbons, returns to the negative binding posts by passing through three side rods placed at the angles of an equilateral triangle parallel with and equidistant from the carbons.

It is claimed that the joint magnetic action of the current flowing through these rods keeps the arc balanced so that the carbons are consumed evenly. The effect of this arrangement is to give a very steady light.

Another novel feature is the form of automatic circuit opener. It consists of a short piece of No. 18 or 20 bare copper wire attached at one end to a clip fixed to one of the rods above referred to, the other end being slipped into a similar clip at the top of a short post on the base of the lamp. This wire is stretched across the diameter of the inner space so that it comes into close proximity to the lower carbon. When the lower carbon is burned down to the limit the wire is burned in two and the current is thus cut off. This automatic cut-out is equally effective, whether the lamp is burning normally or whether the current is reversed.

The enclosing globe of the "Petite" indoor lamp is made in three shapes, and

FIG. 1.—PETITE LAMP WITH STANDARD GLOBE.

FIG. 2.—LAMP WITH EGG-SHAPED GLOBE.

serves as well for the outer globe as for the inner. The out-door lamp is provided with outer globes, one design of which is shown in Fig. 2 of the accompanying illustrations.

Fig. 1 represents an indoor lamp with the "Standard" globe, which is cylindrical in shape, with one end rounded. Another design, the stalactite globe, gives a very graceful form and is very ornamental, and the same may be said of the egg-shaped globe.

The "Petite" lamps are designed to burn in or out of doors singly on 110-volt circuits; two in series on 220-volt, or 5 in series on 500-volt circuits, and singly on 220 volts. They are finished in polished brass and old copper, and the globes come in three varieties, viz.: clear, for outside use; opal, for inside use, and redtag for inside use for lamps burning singly on 220 volts.

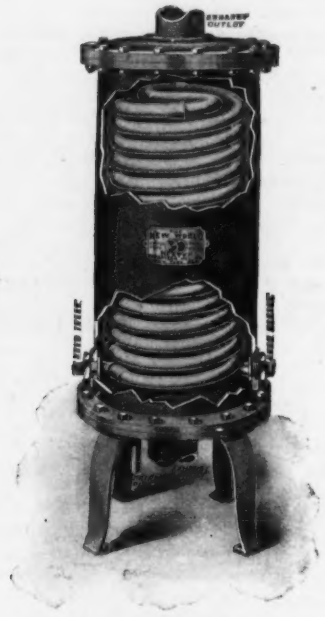
The American Electric Vehicles.

A line of motor-driven automobile vehicles is being developed by the American Electric Vehicle Company, associated with the Indiana Bicycle Company, of Indianapolis. The essential points of these vehicles, which are designed for runabout, stanhope, trap, brake, brougham or delivery wagon bodies, are as follows: The steering is effected by the usual side pivots on the forward wheels, the running gear being made of cold-drawn, seamless steel tubing, with brazed joints. All wheels have ball bearings, with tangent-wire spokes and single-tube pneumatic tires on the lighter, and wooden spokes and cushion tires on the heavier running gears, and are made up in three sizes fitted for the various weights. The motor (one only being used per vehicle) is multipolar, rigidly mounted on the running gear, its armature being on the sleeve attached to the casing of the balance or differential gear, which in turn drives pinions meshing inside enclosed gear cases with gears on the wheel hubs, one of these pinions from the balance gear running, of course, through the armature sleeve. Three sizes of motors are used, rated at 1½, 2½ and 3½ horse-power, respectively. The battery consists of forty-four polarization cells, varying in size from 60 ampere hours to 125 ampere hours, the weight of the lightest being 9 pounds per cell. These are placed in four trays of eleven cells each. A Thomson storage-battery charge-indicating wattmeter is used in the battery circuit. The three speed variations are obtained by connecting the four battery trays all in multiple, in multiple series and all in series, this being accomplished in the coptroller placed under the seat. The reversal is effected by a separate handle which is removable to render the carriage inoperative. Braking is effected by a band brake on the periphery of the compensating-gear case. For delivery wagon service the company estimates the average cost of a two-horse delivery wagon, exclusive of the driver's wages, with a 33 per cent. depreciation, at about $1100 per year, and an electric delivery wagon, with the same depreciation, at about $700 per year.

A New Copper-Coil Feed-water Heater.

The accompanying illustration represents the "New World" return copper-coil feed-water heater, which is made by the Robertson Manufacturing Company, 203 Fulton Street, New York City.

Steam users who study the economical running of their plants are constantly looking around for means to reduce their running expenses. Fuel represents a large percentage of loss, owing to the great amount of heat units lost by permitting the exhaust steam from the engine and pumps to be wasted when discharged direct to the atmosphere. To avoid this loss experiments have been made from time to time, but not always with successful results. Appreciating the necessity for some means of utilizing the maximum amount of heat from what otherwise would be complete loss, the Robertson Company has designed this feed-water heater.



NEW FEED-WATER HEATER.

The water inlet and outlet to this heater are both located at the lower part of the shell, but on opposite sides, thus doing away with the many objections to the piping-up of heaters in which the outlet is generally at the top and on the same side as the inlet. The coil is made of the best seamless drawn copper tubing, and is of the proper dimensions to give ample surface to heat the feed water rapidly to a temperature of 210 degrees Fahr., or within two degrees of that of the exhaust under ordinary conditions.

The feed water is carried through the coil to the top of the heater, and by means of the company's patent expansion return (which is so constructed that it does not in any way retard the flow of water or increase the friction) again passes down to the point of discharge at the bottom of the shell, there meeting the exhaust steam where it is hottest, and thus getting the benefit of the hottest steam as it enters and leaves the heater. The water in passing through this heater does not come into contact with any metal but copper, therefore there can be no rusting out, and it is stated that all galvanic action is avoided.

Other features of the "New World" heater that commend themselves are the freedom allowed for expansion and contraction both lengthwise and spirally. Both the inlet and outlet connections being at the bottom of the shell give the body of the coil freedom to expand and contract, while at the same time the coil is so brazed that chafing or vibration is impossible. Where it is found necessary to join the tubing it has been done by expanding and lapping the tubes and then brazing them with No. 6 hard brazing solder. By this means the chance of leakage is reduced to a minimum.

All the coils are tested hydraulically to 600 pounds pressure to the square inch before being placed in the shell. The heater shells on all sizes up to 300 horse-power, inclusive, are made of the best gray cast iron and in the larger sizes of steel, and tested to 50 pounds to the square inch. Each shell is provided with a stuffing box and gland nut, where the coil connects with the same. The stuffing box is so arranged on the outside of the heater that it can be packed while the heater is in use.

NEWS OF THE WEEK

Financial Intelligence.

THE SPRAGUE ELECTRIC COMPANY has declared a dividend of 3 per cent. on its preferred stock, payable on November 1.

DIVIDEND.—The directors of the New England Telephone & Telegraph Company have declared a regular quarterly dividend of $1.50 per share, payable on November 15 next.

THE METROPOLITAN STREET RAILWAY COMPANY, of New York, reports for the quarter ended September 30, gross earnings, $2,907,562, an increase over the same period last year of $689,620; operating expenses, $1,466,641, an increase of $252,291; net earnings, $1,440,921, an increase of $437,329; other income, $181,737, increase $17,352; total $1,622,658, increase $454,681. After deducting interest, taxes, etc., the surplus is $551,809, an increase of $167,622. It is stated that the report does not fairly represent the real status of the affairs because for much of the time the Sixth and Eighth Avenue lines of the company earned nothing. The operating expenses during the quarter increased 21 per cent. in money, but were 50.6 per cent. of the gross, against 54 per cent. in 1897. The charges increased 36 per cent.

THE GENERAL ELECTRIC COMPANY DECLARES A DIVIDEND.—On October 24 the directors of the General Electric Company, at their meeting in Boston, declared a dividend of $11.66⅔ per share on the preferred stock of the company, as reduced, payable on and after November 15 next. This dividend, it is stated, is equal to $7 per share of the preferred stock, as it existed prior to the reduction. It is on account of the unpaid accumulated dividends on the preferred stock and is equivalent to one year's dividends at the rate of 7 per cent. on the unreduced preferred stock. Checks for the dividend will be mailed to all preferred stockholders who shall have exchanged their old certificates of unreduced stock for new certificates of reduced stock prior to the closing of the books on November 5. The entire amount of the unpaid dividends on the preferred stock from July 1, 1893, when the last dividend was paid, to August 17, 1898, the date of the reduction of the capital stock, amounts to $1,527,885, which is $59.89 upon each share of the reduced preferred stock. President C. A. Coffin has issued a circular to the stockholders, notifying them of the declaration of the dividend.

Special Correspondence.

NEW YORK NOTES.

THE INCOME OF ELECTRIC VEHICLES.—The Electric Vehicle Company has stipulated the minimum amount which its cabmen must bring in per day. This must average $4, or the men will lose their places. As an incentive there is also a premium offered above the wages of $2 a day, this premium being one-third of all turned in over an average of $5.

ELECTRIC VEHICLES IN A PARADE.—In the jubilee parade of wheelmen on the evening of October 31 there were many automobile vehicles, nine of which were electrically propelled. Four of these were vehicles of the Riker Electric Motor Company and five those of the Electric Vehicle Company, the latter being quite elaborately illuminated with colored incandescent lamps.

THE THIRD AVENUE RAILROAD COMPANY has awarded the contract for the electrical equipment of its lines. The Westinghouse Electric & Manufacturing Company will furnish the electrical apparatus to the value of $4,500,000. The underground construction was let to the National Conduit & Cable Company for $1,500,000, and the Johnson Company received the contract for 15,000 tons of 110-pound rails. The castings, such as yokes, hand-holes, etc., will be supplied by the Pennsylvania Steel Company.

THE VISIT OF A NOTED FRENCH ENGINEER.—M. Maurice Hutin, well known to electrical scientists through his joint inventions with M. Leblanc in the line of alternating-current motors and transforming devices, is now in this country on business connected with the reorganized work of the Panama Canal. M. Hutin states that he has been forced to abandon his electrical work, which is, however, being carried on by M. Leblanc, through pressure of other duties, notably those connected with the canal project.

BROOKLYN ELEVATED TRAINS ON THE BRIDGE.—An agreement has been reached between the Kings County Elevated and Brooklyn Elevated Railroad companies under which the trains of the first-named company will cross the bridge to Manhattan. The Kings County road is to pay $83.33 a day to the Brooklyn Elevated Railroad Company for the use of the tracks, the amount being one-third of the minimum cost. It will run one train for every two of the Brooklyn elevated trains, or 883 cars a day. For each additional car 10 cents extra will be paid.

AN INDICTMENT was found by the Kings County grand jury against the Brooklyn Heights Railroad Company on Saturday last for permitting its men to work more than ten consecutive hours out of twenty-four, and also because it required them to do so in violation of the law. District Attorney Marean recently brought the matter to the attention of the railroad company, and the latter promised that the abuse would be stopped and that a schedule that would comply with the law would be fixed. It is now alleged, however, that nothing was done in the matter by the railroad company, and Knights of Labor Assembly No. 75 again appealed to the district attorney, with the result above noted.

CELEBRATING THE OPENING OF THE EIGHTH AVENUE ELECTRIC ROAD.—One night last week a leader of one of the West Side Assembly districts gave a "trolley ride" to his constituents in celebration of the opening of the Eighth Avenue conduit road. Twenty-five cars, brilliantly illuminated, and decorated with flags, etc., started from the corner of Fourteenth Street and proceeded to Harlem. The head car of the procession contained a brass band, which enlivened the occasion with music, and attracted thousands of people to the avenue. The trip was attended with unbounded enthusiasm, as was also the return ride to Seventeenth Street and Eighth Avenue, where a meeting was held.

RECEIVER FOR THE JOHN STEPHENSON COMPANY.—Mr. Charles H. Davis, president; Leander M. Delamater, secretary and treasurer, and A. L. Phillips and B. F. Flint, directors of the John Stephenson Company, the well-known car builders of this city, have begun an action to dissolve the corporation. Justice Cohen, to whom the application was made, appointed as receivers Mr. Albert A. Wilcox and Louis Stern. The petition states that the company cannot meet its maturing obligations. The company is carrying out a number of important and valuable contracts, from which, if they can be completed, considerable profit can be realized which will be of benefit to the creditors of the company. The assets, it is stated, amount to $1,175,776, and the liabilities to $788,782. The capital stock of the company is $150,000 and its pay roll amounts to about $4000 a week. The principal stockholders are H. C. Valentine, $80,000; C. H. Davis, $23,000; J. A. Tackaberry, $14,900; L. M. Delamater, $13,400; N. C. Rogers, $3200, and D. S. Egleston, $2800.

THE MEETING OF THE NEW YORK ELECTRICAL SOCIETY.—The New York Electrical Society met on Wednesday evening, October 26, in the Pearl Street sub-station of the Kings County Electric Light & Power Company, where the general manager, Mr. W. S. Barstow, made a short address on the multiphase generating and distributing system built by the Brooklyn Edison Company, and now owned by the Kings County Company, after which the members and their friends were shown as much of the system as could be seen in one evening. The company was divided into six parties and taken about the circuit of the three stations, namely, the union generating station, station A and the Pearl Street station, at different times and in different order, being transported from station to station in special cars provided by the Brooklyn Heights Railroad Company. Refreshments were served in the stock room of station A, after the visits had been completed. The occasion was perhaps the most instructive and entertaining meeting ever held by the society, and will probably be followed by meetings of the same society in other similar ways and by the visits of other societies to the same system. The following named gentlemen were elected members of the society: Charles E. Spiers, D. Van Nostrand Company, New York; H. Ward Leonard, Bronxville, N. Y.; Harold P. Davis, 918 Union Street, Brooklyn, N. Y.; John C. Slack, 123 Oak Street, Greenpoint, Brooklyn, N. Y.; James H. Mason, 152 East Twenty-third Street, New York; W. F. D. Crane, Reynolds Terrace, Orange, N. J.; Dr. F. S. Kolle, 273 Prospect Avenue, Brooklyn, N. Y.; William A. Brown, Jr., assistant chief electrical engineer Pennsylvania Railroad, Philadelphia, Pa.; Frank D. Sweeten, junior member Vallee Brothers & Co., 625 Arch Street, Philadelphia, Pa.; William A. Brown, chief electrical engineer Pennsylvania Railroad, Broad Street station, Philadelphia, Pa.; Charles Shirley, manager Postal Telegraph Cable Company, 253 Broadway, New York; Albert Eckert Chandler, Postal Telegraph Cable Company, 253 Broadway, New York; Edward J. Powers, 45 Cedar Street, New York; B. F. Hamilton, 510 West Twenty-third Street, New York; Mortimer Lewis Newman, 107 East Ninetieth Street, New York; Lawrence Strauss, 120 East 117th Street, New York; G. Herbert Condict, chief engineer Electric Vehicle Company, 1630 Broadway, New York; James Appleton, chief engineer construction department Electric Storage Battery Company, Drexel Building, Philadelphia, Pa.; Dr. Jean F. Chauveau, Jr., 216 West 103d Street, New York; George N. Moore, assistant superintendent Edison Electric Illuminating Company, Fifty-third Street station, New York; James J. McKenna, Maintenance Company, St. Paul Building, New York; H. B. Kirkland, 120 Liberty Street, New York; Adolph L. Goldschmidt, 425 East Fiftieth Street, New York; John J. Breslawsky, Leonard & McCoy, 118 Liberty Street, New York, 1735 Madison Avenue, New York; John T. Hunt, Zimdars & Hunt, 127 Fifth Avenue, New York; William M. Stewart, New York Telephone Company, 15 Dey Street, New York; Horace Dowie, 363 Jefferson Avenue, Brooklyn, N. Y.; Hiram D. Torrie, Jr., Riverside, N. J.; Henry M. Jackson, president People's Light & Power Company, Newark, N. J., and Dudley Farrand, People's Light & Power Company, Newark, N. J.

THE MEETING OF THE AMERICAN INSTITUTE.—The one hundred and twenty-eighth meeting of the American Institute of Electrical Engineers was held at the New York headquarters on the evening of October 26, the paper for the evening being entitled "An Electrical Survey Through the Borough of Manhattan, New York City," presented and read by A. A. Knudson. The paper described a complete set of tests made throughout the city to determine the existence and location of any stray currents, very few naturally being found, owing to the almost entire absence of overhead trolley roads in this part of the city. Some stray currents were, of course, found on the branch of the Union Railway running through 135th Street, but tests along the lines of the open-conduit lines gave no indications, as would naturally be expected, owing to the fact that these lines have a metallic return, both positive and negative, being insulated from the ground. Tests throughout the central uptown part of the city indicated some leakage, which was detected by means of telephones as from incandescent lighting circuits, the maximum difference of potential be-

tween the elevated railroad columns and the water hydrants being about 0.15 of a volt. In the neighborhood of the Brooklyn Bridge considerable differences of potential were found, indicating a flow from the Brookiyn end toward the New York end, and thence via the many available routes back to the Kent Avenue power station. This might be expected, as the Brooklyn end of the bridge is in a very congested trolley district, and current would tend to flow from this in almost any direction outward, sweeping around eventually to return to the power station. Further tests made since the trolley cars were put on the bridge showed, if anything, a slight rise of this current instead of a return current from those cars sufficient to balance it. The maximum difference of potential between the bridge structure and ground was found to be about 2¼ volts. The paper discussed the possible effect of this potential difference on the cast-iron bridge anchorages, but no conclusions on the subject were reached. One interesting point shown in the paper was the reduction of rail-cross section on some of the Union Railroad Company's track, showing, as William Maver, Jr., aptly expressed it in the discussion, a notable case of the "biter bitten." President A. E. Kennelly announced that the association had appointed a committee on co-operative research to undertake the work proposed at the general meeting in Omaha in the line of classifying and co-ordinating the results of thesis work in electrical lines undertaken at the various engineering schools. The committee requests suggestions from the members of the institute and others as to questions of practical importance needing scientific investigation, and will transfer these suggestions to the heads of departments in the institutions, afterward collecting the results obtained and publishing them in the institute's transactions. At the meeting of the executive committee in the afternoon the following associate members were elected: John McL. Murphy, electrical engineer, Safety Third Rail Electric Company, 5 Beekman Street, Room 223, New York; F. K. Vreland, second assistant engineer, Crocker-Wheeler Electric Company, residence, 228 Orange Road, Montclair, N. J.; J. E. Woodbridge, editor THE ELECTRICAL WORLD, 9 Murray Street, New York. The following associate members were transferred to membership; C. H. Wordingham, city electrical engineer, Manchester, England; William Stanley, electrical engineer and inventor, Pittsfield, Mass.

ELECTRICIANS AT A THEATRE PARTY.—The theatre party referred to in last week's issue of THE ELECTRICAL WORLD proved so satisfactory and enjoyable that a permanent organization was promptly formed to arrange for similar entertainments in the future. The committee which looked after the details connected with the affair was paid the compliment of being unanimously elected to continue the work. It is probable that the next event will be announced for just after the close of the Lenten season, and it is safe to predict that those who were present on October 25 will endeavor also to attend it. For the benefit of the brethren in other cities who may wish to give themselves a similar treat, it may be mentioned that the idea of the theatre party originated during luncheon one day in a well-known downtown restaurant much frequented by those engaged in electrical pursuits. Two or three of those present were arranging for a theatre party, and the suggestion was made that several others be invited to join, the final result being the appointment of a committee, of which Mr. Harris W. Baker was made chairman, Mr. H. B. Kirkland secretary, and Mr. John H. Dale treasurer, the other members being Mr. E. S. Keefer and Mr. F. W. Harrington. A list was prepared with care of those whom it seemed desirable to invite, and preliminary notifications sent out. As soon as responses were received the committee selected the opera of "The Fortune Teller," and arranged to have electric carriages to convey the party from Wallack's Theatre to the Waldorf-Astoria, where a cosy suite of rooms had been engaged for the evening. A dainty and excellent supper was also ordered, a string band being engaged to add to the gaiety of the occasion, the evening winding up with dancing. The arrangements were so well planned that when the time came everything passed off most pleasantly. The opera was thoroughly enjoyed, so was the exhilarating ride in the electric carriages, and likewise the supper and the sociable reunion at the Waldorf-Astoria. A novelty in the way of a bouquet of roses studded with miniature electric lamps with a dry battery as the source of current was prepared by the committee and presented to Miss Neilsen during the performance. This bouquet was evidently much appreciated both by Miss Neilsen and by the audience. The attendance at the theatre party was not wholly confined to New Yorkers. Mr. and Mrs. Henry B. Cutter were present from Philadelphia, and Mr. and Mrs. A. T. Clark and Col. R. B. Edes cames over from Boston. The others present were: Mr. F. C. Bates, Mr. and Mrs. Harris W. Baker, Mr. and Mrs. C. A. Benton, Mr. Murray Burtis and Mrs. E. A. Lowe, Mr. and Mrs. John H. Dale, Mr. J. S. Douglass, Mr. and Mrs. D. E. Drake, Mr. and Mrs. P. M. Fletcher, Mr. and Mrs. N. W. Gage, Mr. and Mrs. Victor C. Gilpin, Mr. and Mrs. F. W. Harrington, Mr. and Mrs. Charles H. Howard, Mr. and Mrs. Alex. Henderson, Mr. and Mrs. J. C. Hatzel, Mr. and Mrs. T. M. Hartyn, Mr. and Mrs. John T. Hunt and Miss Hunt, Mr. and Mrs. Oscar Hoppe, Mr. E. W. Irwin and Miss J. E. Buckingham, Mr. J. Jones, Jr., and Miss E. J. Jones, Mr. and Mrs. W. J. Johnston, Mr. and Mrs. Philip H. Klein, Jr., Mr. and Mrs. E. R. Knowles, Mr. H. B. Kirkland, Mrs. Mary F. Kelly, Mr. and Mrs. E. S. Keefer, Mr. F. A. Muschenheim and Miss Clementine Denito, Mr and Mrs. John T. McKeever, Jr., Mr. and Mrs. E. P. Morris, Mr. George D. Pitman, Mr. and Mrs. Leonard F. Requa, Mr. Leonard F. Requa, Jr., Mrs. Herman Simon, Mr. and Mrs. W. C. Turner and Mr. W. B. Van de Water and Miss Alice Smith.

NEW ENGLAND NOTES.

MESSRS. R. S. HALE & J. S. CODMAN, engineers, have formed a partnership under the above title for the practice of steam, electrical and other engineering. The new firm will make a specialty of boiler and engine testing, report on rented power and the value of steam coals, and will carry on a general business of drawing plans and specifications, making estimates, inspections, reports, tests, etc. The offices of the firm are at 31 Milk Street, Boston.

MR. R. L. WHITMAN, of Whitman & Couch, Boston, the well-known telephone manufacturers, has just started on a four weeks' business trip, during which he will cover the principal points in New York State, Pennsylvania, Maryland and Delaware, and visit Western cities. We bespeak for Mr. Whitman a favorable reception wherever he may call, not only because of the excellence of the telephone manufactures and specialties of his firm, but also because of his many admirable personal qualities.

THE BIBBER-WHITE COMPANY, Boston, is increasing its office facilities and accommodations, an addition having just been made to the building adjoining its establishment, and the two connected. A large and magnificent private office has been fitted up for Mr. C. E. Bibber and his associate, Mr. Henry W. Burgett, for the management of the numerous electric railways with which these gentlemen are identified. When it is understood that Mr. Bibber only a little over a year ago took up the business of contracting, constructing and financiering of electric railway enterprises it is remarkable that in this time he has completed roads in Maine and Vermont, and is constructing different branch lines connecting Norton, Attleboro, Taunton, Easton and Mansfield, Mass. These represent a system of 38 miles, nearly all of which is completed and the balance will be finished before December 1. The most important contract he has made, however, is for the building of the Albany, Helderberg & Schoharie Railroad, 48 miles long. This is certainly a creditable record of indomitable energy and activity.

BURTON ELECTRIC TANNING PROCESSES.—This was the subject of an address by Mr. George D. Burton, president of the United States Electrical Leather Process Company, at the Electric Potential dinner, held at Hotel Thorndike, Wednesday evening, October 26, and notwithstanding a heavy downpour of rain quite a number of members were present. The preliminary proceedings having been duly disposed of, Colonel Hewins, president of the club, in a few well-chosen remarks introduced Mr. Burton, who proceeded to illustrate and describe by the aid of lantern slides the various apparatus and processes employed. Before commencing his address Mr. Burton placed in a tank, set up in the room and connected to the ordinary 110-volt Edison circuit, a number of kangaroo skins, from which the hair was removed by the Burton process in about twenty minutes during the progress of his remarks. The process of unhairing hides is effected by means of a vat or tank containing suitable solution, in which the hides are suspended and through which the current is passed by means of electrodes partially immersed therein. These electrodes may be of carbon and lead or of lead and copper or of copper coated with platinum. Screens are provided to protect the hides from actual contact with the electrodes, and there are also means for agitating the liquid. Various forms of apparatus embodying these general features were illustrated and explained by Mr. Burton. He said that the effect of the current was to raise the hair from the skin and thus render the hair pores or cells more accessible to the action of the solution than was the case with the existing methods. He further explained that the comparative rapidity of the electric treatment did not injure the leather, but that in some electrical processes heretofore employed undue haste and excessive currents had been the cause of such injury. In this method the temperature of the solution was not materially raised. The effect of this mode of treatment was to plump the skin, rendering it a trifle smaller and finer and firmer. The tanning process, he said, was substantially similar as to apparatus and procedure, a suitable solution for the purpose, of course, being employed. The operation of the current, Mr. Burton considered, was mainly to open the pores of the material, thus affording the tanning solution better access to the pores. He further stated that the matter has progressed beyond the experimental stage, as the tanning processes were already being used commercially in fifteen or sixteen tanneries. Among the principal advantages claimed are saving of time involved and consequent tying up of capital, some improvement in product and a considerable reduction in space occupied, as a tanner using the electrical process may dispense with at least one-third of his vats. As to the actual saving in dollars and cents information was meagre at present, but in one instance it had been found that there was a saving of 16 cents on every 60-pound hide as compared with the ordinary methods. Mr. Solomon, who is a practical tanner in Newark, N. J., at the invitation of the president also made a few remarks relative to his experience with the Burton tanning system. He stated that it appeared to him that the electric current produced a twitching or wavy movement to the material subjected to the process, which, it appeared, loosened the fibres and rendered them more readily acted upon by the tanning medium employed, thus saving time. He also said that as far as his experience had gone the electrical process not only resulted in a saving of time but also in more satisfactory product. Another point to which he referred was to the fact that under the old processes the hair received from the hides was very liable to be of inferior quality, and not so good for many purposes, owing to the long period of time during which it was subjected to the action of the liquor, whereas in the electrical process the hair was not much injured owing to the shorter time of immersion. He desired to call the attention of gentlemen interested in electrical matters to the large field which presented itself for development in connection with industrial enterprises, and more especially in connection with tanning and dyeing of leather. He said that probably 80 per cent. of the colored leather was dyed black, and logwood was employed for this purpose, which after being applied to the material was set or fixed by one of the salts of iron, producing, of course, oxidation, which had a tendency to harden and injure the surface of the leather, rendering it liable to rapid deterioration. If this oxidation could be readily effected by means of electricity without this injurious action it would be a very valuable thing for the tanning industry. He also said that the same kangaroo skins which Mr. Burton unhaired in the presence of the audience in less than twenty minutes would require eighteen days in their tanning.

PHILADELPHIA NOTE.

JUBILEE ILLUMINATIONS.—In addition to the special illuminations referred to in considerable detail on another page of this issue there were several others of a private nature which are worthy of mention. A very pretty little device was shown on the front of the Odd Fellows Hall. It consisted of the well-known three-link emblem of this order, the links being in red, white and blue lamps. This design was on one side of the main entrance, while on the other side was a circle enclosing a five-pointed star. The Hotel Stratford on Broad Street made a simple yet attractive display of a large shield on one side and above the main entrance and an anchor on the other side and in line with the shield. An additional feature of the illumination at this point was the

use of thirteen large brass candelabra at the front of the reviewing stand erected over the sidewalk in front of the hotel. The lamps used on the candelabra were red, white and blue in alternation, and the effect at night, when they were lighted, was very pretty. The Hotel Bellevue, which adjoins the Union League, showed its patriotism by having a waving American flag over the main entrance. The apparent motion of the flag excited a great deal of wonderment to the thousands of beholders. The Hotel Lafayette was very tastily decorated with strings and festoons of electric lights, which covered the front of the building, and above the main entrance was the word "Peace" in plain white letters.

Buffalo and Niagara Falls Notes.

THE TROLLEY LINE from Buffalo through Tonawanda to Lockport is to be extended to Olcott on the Lake Ontario shore. It is reported that the right of way is already secured, and that an effort will be made to build the line before winter, though it is hardly likely that it can be done.

CONTRACTS are let for the electric apparatus to be used by the McKinnon Dash Company at Black Rock. The 100-hp motor will be furnished by the Westinghouse Company, the direct-current generator motors by the Northern Electric Company, and the 60-cycle alternator and welding apparatus by the Thomson Welding Company. This is the first introduction of machinery of the sort here.

THE LEADING BAKERS of Buffalo are asking for electricity for power. As they use it so irregularly through the day it ought to prove more economical than steam. There is talk also of adapting the current for heating the ovens, which appears not to have been done anywhere as yet. The Mugridge bakery is already taking the current, and the Ovens and Collins companies are negotiating. The amount of power needed is not large.

MUCH SATISFACTION is felt over the announcement made this week that the Canadian Niagara Power Company has paid its rents. For a considerable time they have been allowed to lapse, and it was feared that this was an indication that there was doubt about the keeping up of the franchise obtained on the other side of the river. The payment of $12,500 to the Queen Victoria Niagara Park Commissioners clears up all claims to November 1, and is accepted as proof that the company is not going to give up its franchise.

THE TONAWANDA CATARACT POWER COMPANY was this week added to the many that already exist in direct connection with the power development venture. The capital stock is $100,000, and is controlled by the New York stockholders of the original company, as are all the secondary companies. The object of the company is to distribute the Niagara power current to Tonawanda and vicinity. An Albany dispatch announcing the incorporation expresses surprise that the articles do not give the company power to manufacture electricity, but only to distribute it. This is the simplest matter possible, for the manufactory is already established in Niagara Falls. Work has already begun on a transformer house for the new company.

THE UNION CARBIDE COMPANY at Niagara Falls is already at work on the enlargement of its works, and has hired Harry L. Noyes, of Buffalo, as engineer. The company is now using only 1100 horse-power from the tunnel, but has contracted for 5000 horse-power additional, with an option on 10,000, which appears to be much more than was at first reported, and indicates that very extensive operations are contemplated. Though the production of the basis for acetylene gas by the fusing of coke and lime in an electric furnace, as carried on by the company, is still in its infancy, it would appear that the sale of the product as well as the process of manufacture is assured. The company is said to have the millions of the United Gas Companies of Chicago behind it.

WITH ONE SWITCHBOARD in the new lighting station in Buffalo finished and a second to be completed this week, it is expected that some of the apparatus can be started up in a week or two. The station is to have nine switchboards in all. The finished one is a rotary transformer board for the 550-volt power service, and contains two rotary converter panels and one feeder panel. The second board is for the twelve arc machines and has three panels. The next board will be for the synchronous motor circuits, and will contain six panels. All are of Vermont marble. The eleven transformers furnished by the Conduit Company are in position, and the switchboards are in process of erection by the General Electric Company. There will be four of these boards, two of seven panels each of the high-tension service, one for the 352-volt secondary service and the other for the 2200-volt circuits.

St. Louis Notes.

THE LINDELL RAILWAY FRANCHISE.—There continues to be a great deal of opposition to the franchise lately granted by the Municipal Assembly. It is in the hands of the mayor awaiting his signature. It is still in doubt whether he will sign it or not.

THE CITY'S police, telephone and fire alarm wires are not yet under ground in the conduit district, and many things indicate that when December 31 arrives, the day on which all wire in the conduit district must be under ground, the city itself will be the principal violator of the law and the principal cause why Bell telephone poles will still be standing in the conduit district.

THE STANDARD TELEPHONE COMPANY, which has bought all the lines and equipment of the Central Missouri Telephone Company and assumed control of the system, proposes to build a line through St. Louis early in the spring. The new purchase gives the company about 1000 miles of lines in the State, and when all the connections are made it will give Kansas City communication with 150 Missouri towns.

Mexican Notes.

AN ELECTRIC LIGHT PLANT has been installed in the State penitentiary at Puebla. The two large dynamos were purchased in the United States.

A PRIVATE COMPANY of Mexican capitalists has just been formed for the purpose of establishing an electric lighting plant in the city of Tepic, Territory of Tepic.

THE CITY OF CULIACAN is now installing an electric light plant, and it is expected that its formal inauguration will take place about November 15. The electrical equipment was purchased in the United States.

THE TRUNK LINE of the telephone system of the State of San Luis Potosi, extending from the city of San Luis Potosi to the Angostura hacienda, a distance of 250 miles, has just been put in operation. Several lines of new telephone wires will soon cover that State.

ACETYLENE GAS was recently introduced into the city of Mexico, and has come into rapid favor among the smaller shopkeepers. But the explosions and consequent fires have become so numerous from the careless handling of the gas that a stringent order as to the manner in which it shall be used has been promulgated by the municipal authorities.

THE INAUGURATION of the new electric street railway line connecting the cities of Torreon, State of Coahuila, and Lerdo, State of Durango, will soon take place. This will be the first electric line to be placed in operation in Mexico. The track of the road was completed a short time ago, and it has been operated by mule power pending the installation of the electrical equipment.

A GANG OF THIEVES whose special object seems to be to steal telegraph and telephone wire, they even cutting them from the poles, have been operating in the city of Mexico for the past several weeks. Several miles of valuable copper wire have been stolen by them, and the telegraph and telephone business badly interfered with at times on account of the depredations. The thieves sell the wire to junk dealers for good prices, and are apparently doing a profitable business. If captured they will have to pay the death penalty.

Canadian Notes.

MR. JAMES A. BELL has been instructed by the City Council of St. Thomas, Ont., to make a report to Council upon the cost of installing a municipal electric lighting plant.

AT A SPECIAL MEETING of the Orillia, Ont., Town Council, Mr. R. J. Parke, of Toronto, was appointed to prepare specifications for the proposed Ragged Rapids water power scheme.

THE CATARACT POWER COMPANY, of Hamilton, Ont., has connected its transformers with the Hamilton city wires of the Hamilton Electric Light & Power Company, and the incandescent lights were supplied with current developed at Decew's Falls, which are about 34 miles distant from the city.

AN IMPORTANT QUESTION is to come up at the next meeting of the Hull Electric Company, of the city of Hull, opposite Ottawa, in Quebec province. A project is on foot to alter the cars now in use so that they can be run at a speed of 40 miles an hour. By doing this less cars will, it is calculated, be required, and therefore less men will be employed.

MR. W. C. McDONALD, the millionaire tobacco manufacturer of Montreal and the generous benefactor of McGill University, of that city, has again demonstrated the interest he takes in that institution of learning by presenting to the department of electrical enginering the sum of $30,000, with which to purchase the best and most modern electrical apparatus. This gift will enable the department to acquire much needed apparatus, and it is said that when all is in place the department will take first rank among the many of its class on this continent.

IT IS confidently predicted that the valley of the St. Maurice River, which is now a densely wooded wilderness, will in ten years be a hive of industry. Three immense enterprises are already at work—the Shawinigan Power Company, Laurentide Pulp Company and the Canada Iron Furnace Company. The first-named company is preparing to develop electric power in large quantities, available for industries which will follow, and for transmission to Montreal, Quebec and other manufacturing centres. The natural lay of the land and water is such that power can be developed at a minimum of cost. The company is proceeding to install a plant which will be able to develop 30,000 horse-power, to be eventually increased to over 100,000 horse-power. The engineers estimate that 200,000 horse-power can be developed.

THE TORONTO STREET RAILWAY COMPANY is considering a scheme for a system of radial electrical roads to run out of Toronto through the Province of Ontario. The matter has been before the company's board in an informal way for some time, but a meeting was held last week to see if some practical scheme could not be evolved. The assembling in Toronto of many well-known capitalists on October 21, who are all largely identified with electric railway ventures, lends color to the report. The party held a conference at the street railway company's board rooms, but the result of the meeting has been kept a profound secret. It is known that a scheme for an extension of the Toronto street railway lines to the outlying suburban districts was under consideration, but there is an impression that something of greater moment is contemplated than the local radial extension.

French Notes.

THE LIGHTING OF THE GRAND THEATRE AT BORDEAUX.—At a recent meeting the Municipal Council of Bordeaux approved the appropriation recommended by the commission for lighting the Grand Theatre by electricity. The present contract for lighting the stage by electricity, made with the gas company in 1890, expired September 1, and the company refused to renew it. The new installation becomes, therefore, a matter of necessity, and the plan is to light all the dependencies of the building. The generators and gas engines are to be placed in the sub-basement under the lobby. The installation all complete will cost 83,000 francs, payable in five yearly installments, and must be finished by August 28 next. The award for the contract was made at the City Hall. There were three bidders, two of whom were thrown out because they could not guarantee to furnish the type of engine required, the requirement being that it must be furnished by the manufacturer. This naturally left only M. Trische, a Bordeaux electrician, who represents this particular manu-

facturer, as the sole bidder, and the contract was awarded to him at 79,000 francs. It was with this same practical engineer that the administration had proposed to treat for a private contract.

IMPROVEMENT IN THE SURFACE CONTACT SYSTEM of electric railways, by the General Electric Traction Company.—These improvements concern the roadbed of the type of railway where the car takes power from contact flush with the ground and provided with a concealed interrupting mechanism controlled by the passage of the car. It has been found extremely difficult to build these contact boxes so that they will stay tight. Moisture gets in and condenses on the surfaces of the contact pieces, with the result of keeping them electrically in connection when they should be insulated from one another. In this way the contact boxes may become a source of danger to passers in the street. To get rid of this rather serious difficulty the contact portion of the box is connected to the rail through a resistance, which is sufficiently high to render the leakage through it on the passage of the car quite small. If a film of water or ice forms between the movable piece and the contact, making the latter alive, a current is at once established and the heat generated in the film of moisture will volatilize it at once. The invention contemplates in addition a system of piping to convey artificially dried air to the contact boxes during wet weather. The pressure required to force this air through the system is quite low.

THE TEACHING OF ELECTRICAL SCIENCE IN PARIS.—The first attempt to set up a special school for electrical science in Paris was no earlier than 1894, and even then the Government took no interest in the matter. Everything that was done was at the initiative of the International Society of Electricians, which was organized in 1881, and which established a central electrical laboratory. The courses offered by this establishment, which is known by the name of Ecole Supérieure d'Electricité, last one year, and comprise lectures and practical work. The latter portion includes laboratory work, machine-shop work, machine testing, inspection of the stations and electrical works in the various districts of Paris. Graduates from certain schools, such as the Ecole Centrale, the Ecole des Mines, the Ecole Polytechnique, etc., are admitted without examination; all other students must pass an examination. The Minister of Commerce has authorized the Ecole Centrale to contribute to the support of such of its students as have passed its graduation examinations, and who wish to complete their electrical education at this school. The object of the school is to furnish to young men who intend to be electrical engineers and who have received a general technical education the means of completing their education in one year. The number of pupils that can be received is very limited, owing to the lack of funds, which makes it impossible to buy sufficient apparatus. There were twelve the first year, sixteen in 1896, and, finally, last July twenty-seven were graduated. As is the case at the Montefiore Institute, pupils from all nations are admitted. At the last voting of the budget of 1898, it was decided to furnish the Government with a special fund to establish courses in electrical science at each of the three Schools of Arts and Professions. The curriculum of these establishments has been rearranged so as to give this new study a place ranking with that which the subject has made for itself among the industries. The new programme makes it evident that great care will be bestowed on electrical measurements, the study of alternating and multiphase currents, the transmission of power, electric chemistry, electro-metallurgy, telephony and telegraphy. The last part, entitled "practical work," details the tests, experiments and manual work which the pupils will be required to take. It seems probable, and we earnestly wish, with M. E. Payen, who is an expert in these matters, that instruction in electricity in France will be put on a par with that in other countries. Moreover, private initiative will doubtless enter the field also. The University of Grenoble has announced that it will add to its faculty of sciences a chair for the instruction of the theory and practice of industrial electricity. Being situated in a country where numerous waterfalls invite the installation of electrical enterprises this course should be of the greatest service.

General News.

THE TELEGRAPH AND TELEPHONE.

PEORIA, ILL.—The Citizens' Telephone Exchange has been organized here with a capital of $200,000. The incorporators are Deloss Brown, M. F. Farwell and John Skinner.

LOCKPORT, ILL.—The People's Telephone Company has been organized in this place with a capital stock of $12,000. The incorporators are Allen G. Hawley, Charles B. Cheadle and Thomas A. Cheadle.

HAVANA, CUBA.—The central telephone station here was destroyed by fire on the night of October 17. It is stated that the electric light wires came in contact with the telephone wires, and the fire was the result.

BOSTON, MASS.—A feat in telephony, marking the farthest advance yet in the science, was accomplished a few days ago, by talking over the wire from Boston to Kansas City. The distance is about 1560 miles, and it is said to be the longest distance ever covered by a single telephonic circuit.

DANVILLE, ILL.—Danville and Indianapolis are to be connected by a copper line of telephone wires as soon as the line can be constructed. A company of Indianapolis capitalists has been formed, having plenty of money behind it, and the work has already been begun. It is called the Danville Telephone Company, with headquarters at this place. The right of way has been secured from Indianapolis to Crawfordsville, and agents of the company are now engaged in securing right of way from there to this city. It is hoped to get in full working order by January 1.

KANSAS CITY, MO.—The Standard Telephone Company bought all the lines and equipment of the Central Missouri Telephone Company a few days ago, and assumed control of the system. This gives the Standard about 1000 miles of lines in the States, and will give Kansas City communication with 150 Missouri towns. The Standard has adopted a plan very much on the order of that used by telegraph companies. In case some one wishes to telephone some town and the wire is in use a message of twenty words may be written and sent by the operator at the same rate that a telegram of ten words would cost.

LA CROSSE, WIS.—It was thought that the recent purchase by the Bell interests of independent toll lines in Minnesota, Iowa and Dakota would cripple the La Crosse Telephone Company to such an extent that it might be forced out of the long-distance business in this territory. This, however, turns out not to be the case. The La Crosse Company, it is stated, has just completed a traffic agreement with the Standard Telephone Company, with headquarters at Britt, Ia., another independent concern, whereby practically all of its former Western connections are regained and many new towns have been added to the toll line lists. A flat rate of 15 cents for five-minute talks to any point on the new system has been inaugurated.

ELECTRIC LIGHT AND POWER.

LIMA, OHIO.—The City Council has decided to investigate the cost of an electric light plant with the view of building one for the illumination of the city.

ROME, N. Y.—The taxpayers of Herkimer voted upon the proposition to bond the village for $13,000 to be used in constructing an electric light plant. The proposition was carried.

MERRILL, WIS.—Fire, originated by a spark from a heated clutch in the main shaft in the power house of the Merrill Lighting & Railway Company, destroyed that plant, together with the B. Scott Lumber Company's mill adjoining. The railway and light company's plant was valued at $10,000, and insured for $3000.

PRESCOTT, ARIZ.—Louis C. F. Lotz, Henry S. Hildreth and Charles Y. Wanpuzer have incorporated the Black Canyon Hydraulic & Electric Power Company, with a capital of $5,000,000. The company proposes to do a general mining business and to develop electric power from the Colorado River at the Grand Canyon. The incorporators are New Yorkers.

ROCHESTER, N. Y.—The construction of the electric light system in Charlotte, N. Y., was awarded by the Municipal Board of that place to the Westinghouse Electric & Manufacturing Company, represented by T. C. Frenyear, of Buffalo. Two generators will be used, capable of furnishing 125 arc lamps of 2000 candle-power each. The bid was for $8450. Work will be begun immediately, and the system will be in working order, according to contract, by January 1, 1899.

ALBANY, N. Y.—The Tonawanda Cataract Power Company was incorporated on October 26 for the purpose of distributing electricity for light, heat and power within the town of Wheatfield and the city of North Tonawanda, Niagara County, and the town and village of Tonawanda, Erie County, N. Y. The capital stock of the company is $100,000, and the directors are Charles A. Sweet and Lincoln A. Grow, Buffalo; Edward D. Adams, Francis Lynde Stetson, Edward A. Wickes and William B. Rankine, New York.

NORWAY, ME.—The electric power plant failed to furnish power a few nights ago because the water is too low to run the dynamos. Streets, stores, residences and other places in this village and South Paris were in darkness. The Supreme Court had to borrow kerosene lamps. Street cars were stalled in Main Street. The large shoe factories, newspaper offices, mills and other manufacturing plants were temporarily without power. The water system of the twin villages, which depends upon electric power, is threatened.

WASHINGTON, D. C.—The introduction of electricity in the State, War and Navy Building has brought about a great improvement in the building in the matter of furnishing light to the employees. Before this was done the average number of 16-cp gas lamps was 144; now the average number of 16-cp electric lamps is 428. The great increase in the quantity of light used by the clerks is an indication of their better facilities for work. The Executive Mansion is now also lighted from the plant in the State, War and Navy Building. The lamps in the two buildings aggregate 3400, and the motors aggregate 27.75 horse-power.

THE ELECTRIC RAILWAY.

SEDALIA, MO.—The Sedalia Electric & Railway Company has been organized, with a capital of $400,000, by C. H. Reeve, J. C. Lelong, J. C. Van Riper, E. C. Evans and A. H. Trader.

TOLEDO, OHIO.—The Toledo Traction Company, of which Norman B. Ream, of Chicago, is the principal stockholder, has purchased the Toledo Electric Company, the purchase price being $325,000.

BELLOWS FALLS, VT.—The Bellows Falls & Saxton's River Street Railway Company has been organized by J. H. Molton, of Burlington, Vt., president; A. N. Awain, vice-president, and George A. Weston, of Bellows Falls, secretary. The company proposes to do a passenger and freight business on its road.

SAGINAW, MICH.—Homer Loring, representing the bondholders of the Union Street Railway Company, who has been receiver of the two local organizations the past year, has bid in the properties for the newly consolidated company. His bid for both was $307,500. The companies will be reorganized under the control of the Boston bondholders.

SANTIAGO DE CUBA.—General Wood has forwarded to Washington a recommendation that concessions to two companies, made up of English, American and Cuban capitalists, be immediately granted. One of these companies desires to construct an electric railway in this city on the overhead trolley system, and the other proposes to build a standard-gauge railway from the city of Santiago to the western limit of the province, to connect there with the line to be built from Havana as soon as a stable government is established.

ELIZABETH, N. J.—The application of the Elizabeth Street Railroad Company for permission to change the motive power of its East Jersey street line from horse to electricity was practically killed by the Common Council. The street committee reported an ordinance granting the desired permission, but coupled it with a provision that the fare for a single ride between the hours of 5 and 7 in the morning and 5 and 7 in the evening should be 3 cents. Mr.

Engle announced that the company could not afford to accept the franchise under the conditions named.

PITTSBURG, PA.—Judge Joseph Buffington has appointed A. L. Sailor and Wm. A. Brown receivers of the Braddock Electric Railway Company. The bill was filed by Isaac M. Heidelberg and A. L. Sailor, president of the company, and Wm. A. Brown, a holder. The bill states that the company is insolvent, the road not in operation and the property and assets are fast depreciating in value. The bonded debt is $40,000, on which no interest has been paid since November, 1897. The company was authorized to run an electric railway in North Braddock and East Pittsburg.

CHICAGO, ILL.—Tracks are now being laid in Plymouth Place south from Polk Street, in this city, for a storage battery or underground conduit line of the General Electric Company, which has held a franchise to this territory for two years. Work was commenced at midnight on October 30, and carried on until 2 o'clock in the morning, when the Western Indiana Railroad Company determined to put a stop to it. A freight train was backed down to the place and derailed in such a way as to stop further work on the new line. The rival gangs of men clashed, and the police were called out. Injunctions have been served at the instance of the Western Indiana Railroad against the officials of the company which is laying the tracks. The courts will be called upon.

BOUND BROOK, N. J.—This place and Plainfield, which are 12 miles apart, are now connected by a trolley line, which was opened for service on October 29. The first car over the new line, which is operated by the Brunswick Traction Company, was in charge of the secretary, Edward H. Radel. The passengers were officials of Middlesex, Somerset and Union counties, and they had with them a band to enliven the occasion. When the car reached Lincoln, Mrs. Emma Engel, president of the Borough Council, took charge of the car and ran it through the town. She had with her Mrs. Flora P. Wrench and Mrs. Olivia Hazard, both members of the Council. When the car reached the station at Lincoln, Mrs. Engel alighted and drove home a nickel spike, which formally completed the line. The new line connects Plainfield and Raritan by way of Lincoln, Dunellen, Bound Brook and Somerville.

NEW HAVEN, CONN.—Stockholders of the Fair Haven & Westville Street Railway Company, of this city, have been called to a meeting on October 31, to act on a proposition for acquiring control of the properties of the New Haven Street Railway Company. The latter corporation owns lines to Fair Haven and Westville competing with the Fair Haven & Westville Company; also branch lines to Cosy Beach, Lighthouse Point, Lake Saltonstall and Morris Cove, and a cross-country line to Mount Carmel, 12 miles distant. It has $1,000,000 of capital stock issued for purchase of the roads of other companies, for construction and equipment, a first mortgage of $600,000, a purchase-money mortgage of $250,000, besides two small divisional mortgages. The company paid last year 2½ per cent. on its stock. It owns or controls about 40 miles of track and about one-half the mileage of all trolley roads centring in this city. The consolidation of the two properties will greatly facilitate traffic and transfers on the New Haven system of trolley roads, which has heretofore been marked by a good deal of friction and public inconvenience.

PERSONAL NOTE.

MR. ARTHUR CLIFTON GARRISON, secretary and treasurer of the Columbia Incandescent Lamp Company, St. Louis, Mo., is to be married November 9 to Miss Frances Billingsley, of the same city. As the executive head of one of the leading lamp manufacturing companies, Mr. Garrison is well known to the readers of THE ELECTRICAL WORLD. Under his management the Columbia Company has made rapid strides, and is turning out excellent goods. We feel sure, therefore, that our readers will join us in wishing the couple a long life of prosperity and happiness.

OBITUARY NOTE.

CLARENCE G. DAVENPORT, who was for several years connected with the General Electric Company at the New York office, and who was a corporal in Company F of the First United States Volunteer Engineers, died in Porto Rico on the night of October 26, of typhoid fever. The deceased was a son of the Rev. J. G. Davenport, of Waterbury, Conn., and was an associate member of the American Institute of Electrical Engineers.

EDUCATIONAL NOTES.

A COURSE OF ELECTRICAL ENGINEERING has been established at the Washington and Lee University, Lexington, Va. Mr. Robert E. Hutton, a graduate of Johns Hopkins University, and manager of the Lexington Light & Power Company, is the instructor in the new course.

THE CATALOGUE of the Michigan College of Mines, Houghton, Mich., has been issued. It contains statements concerning the institution and its courses of instruction for 1898-1900. The course of electrical engineering is in charge of Professors McNair and Hood. Provision has been made for a dynamo room and general electric laboratory, which will be thoroughly equipped with machinery and apparatus necessary to give the student a practical knowledge of the principles taught in the class room.

FREE LECTURES ON PHYSICS AND ELECTRICITY.—A course of twelve free public lectures on physics and electricity is being given by Prof. Samuel Sheldon, of the Polytechnic Institute, Brooklyn, N. Y., under the auspices of the school board for the boroughs of Manhattan and The Bronx. The lectures will be delivered in St. Bartholomew's Lyceum Hall, 205 East Forty-second Street. The first one was given on October 1. Those yet to be delivered are on the dates and subjects named, viz., November 5, "The Mechanics of Gases;" November 12, "Batteries;" November 19, "The Electrical Units;" November 26, "Electrolysis;" December 3, "Magnetism;" December 10, "Electromagnetism;" December 17, "Electromagnetic Induction."

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

THE MARITIME ELECTRICAL ASSOCIATION.—President, F. A. Bowman, of New Glasgow, N. S.; secretary, J. H. Winfield, New Glasgow, N. S. Last meeting, Halifax, N. S., September 27-28, 1898.

THE KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION.—Organized at Topeka, September 26, 1898. President, L. F. Palmer, Leavenworth; secretary and treasurer, J. H. Foley, Leavenworth.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Future meetings: November 4, illustrated lecture by T. C. Martin; December 2, lecture by Prof. William E. Geyer, Stevens Institute; January 6, lecture on "The Electro-Metallurgy of Copper," by John B. F. Hereschoff; February 3, lecture and experimental demonstrations by Prof. M. I. Pupin; March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill. Future meetings and papers for the season of 1898-99: "Practical Points on Electrical Measurement," by W. B. Hale; November 4, "The Electrical Equipment of a Model Printing Establishment," by George A. Damon; November 18, "The Development of the Motor-cycle," by F. B. Rae; December 2, "Practical Points in Street Railway Engineering," by W. A. Harding; December 16, "Wireless Telegraphy," by Arthur V. Abbott; January 6, 1899, "Telephone Engineering—Some Problems Solved and Unsolved," by S. G. McMeen; January 20, "Observations on Ventilating Fans," Gerard Swope.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, Wm. H. Wahl. Programme of lectures for the season 1898-99: November 8, "Concerning Electrical Instruments," by Mr. J. F. Stevens, and "The Status of Electrical Invention," by Mr. William A. Rosenbaum; November 22, "Thermo-electricity," by Mr. C. J. Reed, and "Electric Elevators," by Mr. William Baxter, Jr.; December 13, "The Kite As an Instrument in Meteorological Research," by Prof. Charles F. Marvin, of the United States Weather Bureau, and "Standards of Light for Electric Light Photometry," by Prof. A. J. Rowland; January 24, 1899, "The Practical Application of the Electric Motor to Printing Press Machinery," by W. H. Tapley; February 14, "The Electric Inspection of Street Car Equipments," by Mr. A. B. Herrick; February 28, "Some of the Larger Transportation Problems in Cities," by E. E. Higgins; March 28, "Water Power Electric Plants in the United States," by Mr. B. C. Washington, Jr.; April 25, "Design of Electromagnetic Mechanism, with Especial Reference to High Frequency Telegraphic Receivers," by Prof. Reginald A. Fessenden; May 23, "Electrical Clocks, Historically Considered; with a description of the Most Successful Applications of Electricity to Clocks and the Uniform Distribution of Time," by Mr. James Hamblett. On February 10 Mr. T. Commerford Martin will deliver a lecture under the joint patronage of the institute and the Central Branch of the Y. M. C. A. on the subject of "Electric Power Transmission."

Trade and Industrial Notes.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., state that they have made enough bells to make a ring around the world if they were placed within hearing distance of one another.

THE WESTERN ELECTRIC COMPANY has in stock a large and complete assortment of weatherproof sockets and receptacles for T.-H., Edison and Westinghouse bases. Orders for material of this kind will receive prompt attention.

CLOSING OF ONE OF THE WALKER FACTORIES.—By the time this paper is in the hands of its readers the works of the Walker Company at New Haven, Conn., will be closed down, the work previously handled there being transferred to the works of the Westinghouse factory at East Pittsburg.

"IMPERIAL LAMP GAZETTE" is the title of a four-page sheet devoted to "a monthly discussion of timely topics on incandescent lamps." It will be published on the first of each month by the Bryan-Marsh Company, 136 Liberty Street, New York. A feature of interest in this publication will be the reproduction of circulars issued by prominent stations to their customers.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is meeting with great success in the sale of its combination fuse block and lightning arrester for telephone work. It seems to fill a large demand for an efficient device for protecting telephone apparatus, and the company states that it has yet to hear of a single case where the instrument has failed to operate in an entirely satisfactory manner.

MESSRS. GOULD & EBERHARDT, Newark, N. J., are just shipping to Rock Island, Ill., eight of their improved drills for the United States Government, and some to Brooklyn, N. Y. They have a number of other government orders for their patent extension base shapers for the various arsenals, besides some for automatic gear-cutting machines. Their works have been very busy for some time past working on orders for their improved tools.

THE AMERICAN REFLECTOR & LIGHTING COMPANY, 271-273 Franklin Street, Chicago, has issued a forty-page catalogue, illustrating its Paragon reflectors. These reflectors are adapted to electric, gas and oil lighting, and, it is stated, render available 300 per cent. more light. They are made in a great variety of forms, the object being to have each reflector give the best possible results, all things being considered. It is stated that experiments have demonstrated that the increase of light varies from 300 to 400 per cent.

THE RASTER CARBON RHEOSTAT COMPANY, Chicago, reports that it has lately been asked to consider very flattering offers for some of its foreign patents on rheostats, electric heaters, etc., by syndicates which have investigated and found the rheostat to be of value. The Raster Carbon Rheostat Company is seriously considering the advisability of disposing of its patents in many foreign countries, though the price offered by the syndicate

is said to be large. The company believes it possible to handle these goods without foreign capital, and thus retain its right to the patents.

INSTRUMENTI ELETTRICI.—An illustrated catalogue of electrical instruments, manufactured by C. Olivetti, of Ivrea, Italy, has been received with a notice in English of the special arrangements for export to America. The instruments are largely of school and testing laboratory types, consisting of Thomson galvanometers, standard resistances, Daniell cells, mercury commutators for storage battery work in laboratories, reversing plug switches, lamps for illuminating scales, etc. Some of the instruments embody designs which show considerable ingenuity. The catalogue also states that the house will soon have on the market 12-inch-dial central station ammeters and voltmeters, Wheatstone bridges, potentiometers and a new line of switches.

INCREASING USE OF ENCLOSED ARC LAMPS.—The General Electric Company notes the increasing use of enclosed arc lamps on multiple circuits, and a corresponding decrease in the number of open arc lamps. Within the past few months the Missouri Edison Electric Light Company, of St. Louis, Mo., has placed not less than 700 General Electric single-globe enclosed arc lamps upon its alternating-current circuits. These are used for interior illumination, and it is reported are giving very satisfactory service. They replaced 18-ampere, 30-volt open-arc alternating lamps. The May Shoe & Clothing Store in Denver, Col., is now brilliantly illuminated throughout by 130 General Electric enclosed arc lamps, of both the single and double globe type, and Messrs. Boggs & Buhl, of Allegheny, Pa., have just installed not less than 200 General Electric enclosed arc lamps of the double-globe type in their dry goods department. The whiteness of the light enables purchasers to select their goods with the assurance that the colors will not prove any different when brought to the light of day.

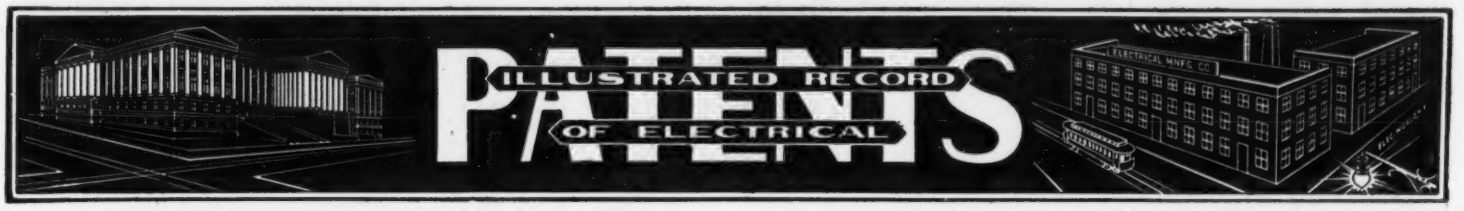
P. & B. PRODUCTS ABROAD.—The Standard Paint Company, of New York, began in July of last year the erection of a factory at Hamburg, Germany, where the same products that are manufactured at the American works of the company are now regularly manufactured for the European trade. The Hamburg factory was finished in February of this year, and is now in complete operation. Mr. R. L. Shainwald, the president of the company, has given a great deal of time and thought to the European enterprise, and states that there is a very large demand for all grades of P. & B. products in European countries. This demand refers especially to P. & B. electrical compound and P. & B. tape and armature varnish. These, it is stated, are in use by nearly all the large manufacturers and traction companies in European countries. Besides the production of the various manufactures for electrical trades the Hamburg works turn out P. & B. rubberoid roofing, P. & B. building, sheathing and insulating papers and P. & B. preservative, roof and structural paints.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, is preparing to move to its new shops at Norwood, Ohio. The company reports that it has been so rushed with orders that it could not spare the time to build the electrical apparatus it will need in its new shops. It is now building two large generators, which are to be direct-connected to a cross-compound engine, built by the Lane & Bodley Company, of Cincinnati. These generators are to furnish power for the machine shop, which is already finished and which is to be driven entirely by electrical power. As soon as these generators are completed the company will move—probably in about two weeks. The Bullock Company has lately gotten out a new type of enclosed motor for use in factories and machine shops, for direct connection to cranes, machine tools, etc. The Pacific Coast Borax Company ordered ten of these motors, aggregating 160 horse-power, to be geared to various tools. The Midland Steel Company ordered this type of motors for its traveling cranes, and two more orders were recently received for motors to be used directly in the headstock of lathes. The New York "Sun" has just ordered from the Bullock Company another 30-hp press equipment, to be similar to the equipments already furnished to that paper. This equipment is to be used on the Bullock teaser system. The Toronto "Globe" has also ordered a like equipment of 40 horse-power for a large Hoe press, and Unwin Brothers, of London, have ordered another press motor like the one they last received from the Bullock Company. The company reports having entered orders for a couple of generators for direct connection to gas engines, and a 100-hp motor and 150-kw generator, slow speed, three bearings, for J. B. King, Roslyn, L. I. Besides the above, the Bullock Company states that it has received many orders for its standard apparatus.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

THE WAR IS OVER, and now our thoughts are all of peace and home. There are, too often, people to be found who have no home, and it is to them these few words are addressed. If you really want a home you can easily get one, but you should act at once before the relapse from the war puts prices on the advance. In Marinette County, Wisconsin, the very finest farming land is to be had now at a most modest figure. Excellent home markets are at hand to take whatever the farmer raises, and good prices are given. These lands are on the Chicago, Milwaukee & St. Paul Railway, and full information concerning them will cheerfully be furnished by C. E. Rollins, Immigration Agent, 161 La Salle Street, Chicago.



UNITED STATES PATENTS ISSUED OCTOBER 25, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

612,810. RAILWAY SIGNAL; W. Andrews, of London, England. App. filed Dec. 20, 1897. The combination of two electromagnetic indicators on the engine, one of which indicators is responsible to a strong current only, and the other to current of less strength; circuit connections, and means located at a signal station to, at the will of an operator, transmit a current of such strength as to actuate both indicators, or a current of less strength to actuate only one of said indicators.

612,875. TROLLEY STAND; W. T. Shyrock, of Allegheny, Pa. App. filed July 20, 1897. In a trolley for an electric railway, a support rotatably secured to the top of the car, a trolley pole pivoted in said support, a rod secured in said support and carrying on one end a supporting block, a tripping block pivoted to said supporting block, a sliding sleeve mounted on said rod engaging rods carried by the tripping block, rods secured to the trolley pole and to a sliding block, whereby the trolley pole is held in engagement with the current wire.

612,880. ELECTRIC CONTACT BOX; J. N. Thomas and W. M. Brown, of Johnstown, Pa. App. filed March 22, 1898. The combination with the vessel and terminal therein of the pedestal connected to one side of the circuit, the nut connecting the said terminal and pedestal and the locking pin.

612,885. ANNUNCIATOR; O. Wiederhold, of Summit, N. J. App. filed October 2, 1897. An armature formed up from sheet metal and provided with a recess in its side conforming in shape to the magnet pole, with which the said armature is to be used, and a thin wall bounding the said recess and extending at an angle to the face of the armature and adapted to be acted on by the magnet.

612,929. INSULATOR AND HANGER FOR ELECTRIC RAILWAYS; W. C. Keithly, of San Francisco, Cal. App. filed Jan. 26, 1898. An insulator and hanger for electric railways of the character described, having a depending bolt, the upper end of which is locked within the insulator, a protecting plate surrounding said bolt below the insulator and an elastic spring interposed between the plate and the insulator.

612,977. ARMATURE WINDING; A. L. Riker, of New York, N. Y. App. filed Nov. 19, 1897. A coil for armature windings composed of a number of turns of round wire forming a hexagonal figure having two straight parallel sides to occupy slots in the armature core, connecting parts in substantially the same plane as the sides, and a downward bend at each end of the coil, the latter being of a thickness of two wires across the bend, and of one wire elsewhere, substantially as described.

612,979. INDICATION BOX FOR SWITCHES; J. B. Struble, of Wilkinsburg, Pa. App. filed March 1, 1898. The combination of two contacts forming terminals of switch-indicating circuits, two movable contact blocks for closing said circuits, and means for shifting one of said blocks prior to the unlocking of the switch and other block subsequent to the locking of the switch in its shifted position, substantially as described.

613,036. TELEPHONE EXCHANGE SYSTEM; C. H. Heilman, of Philadelphia, Pa. App. filed Nov. 21, 1896. The combination with the electromagnet and the switch plunger controlled by the electromagnet of a speaking circuit, a rock lever adapted to open and close the speaking circuit and a key lever pivoted on the plunger and adapted to operate the rock lever.

613,046. AUTOMATIC LEAK OR GROUND CUT-OUT; W. L. Pratt, of Adams, N. Y. App. filed May 20, 1896. An automatic leak cut-out, comprising a hinged arm, a loop connection carried thereby, a double-armed fuse wire normally in circuit holding said arm, a branch circuit to ground, condensers and a magnet included in said branch circuit and an armature adapted to fuse said fuse wire, when the leakage of current has sufficiently accumulated in the condensers so that a discharge to ground will occur.

613,054. ELECTRIC FAN; D. L. Bates and R. H. Bates, of Dayton, Ohio. App. filed July 21, 1898. In an electric fan motor, the combination with a central motor support of a sleeve or tubular support for the armature, fan blades and commutator, the said sleeve or armature support surrounding the motor support and providing a bearing for the armature and fan blades substantially the length of the motor support, a combined oil cup and fan blade support attached to the upper end of said sleeve, and a stationary oil cup at the lower end of said sleeve, in which the latter has a bearing, substantially as described.

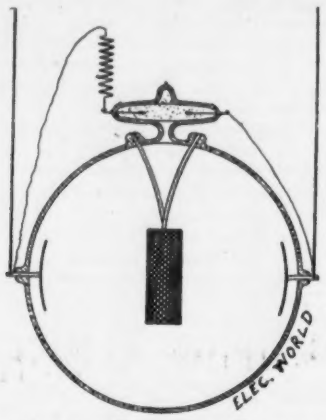
613,062. THERMOSTAT; W. E. Facer, of Cleveland, Ohio. App. filed Nov. 4, 1897. In a thermostat, in combination, a thin metal receptacle filled with an expansible liquid, and having two flexible discs forming parts of its wall, a yoke fixed to said receptacle and extending in front of one disc, a pin secured to said disc, and mechanism actuating upon said pin to draw the disc outward, a spring between the yoke and disc and actuating to press said disc inward, and a circuit-breaking device in contact with and adapted to be operated by the other flexible disc, substantially as described.

613,080. TELEGRAPHY; C. D. Royse, of Greencastle, and W. A. Royse, of Indianapolis, Ind. App. filed Aug. 11, 1897. In a telegraphic system resistance coils connected in the main line in series, a shunt around said resistance coils adapted to normally shunt out said resistance coils, and a telegraphic key adapted, when operated in its usual capacity, to break the shunt around the resistance coils at each depression of said key and throw the current through said coils, and adapted to again complete the shunt when the key is released.

613,084. UNDERGROUND ELECTRIC RAILWAY; G. W. Smith, of St. Louis, Mo. App. filed May 28, 1898. The combination of a car platform, a

lever fulcrumed thereon, a conduit, a hanger operated by said lever and suspended in said conduit, a trolley wire, a flexible tube in said conduit and in which said trolley wire is located, a series of contact shoes placed in and at the top of said tube, and brushes carried by the car and in electrical connection with said contact shoes, substantially as described.

613,090. APPARATUS FOR PRODUCING RADIATION OF ELECTRICITY; C. H. Stearn and C. F. Topham, of London, England. App. filed Dec. 20, 1897. In a lamp or illuminating device for giving light by action of cathode rays on an anti-cathode, the combination with an exhausted vessel, of a cathode within said vessel, an anti-cathode also within



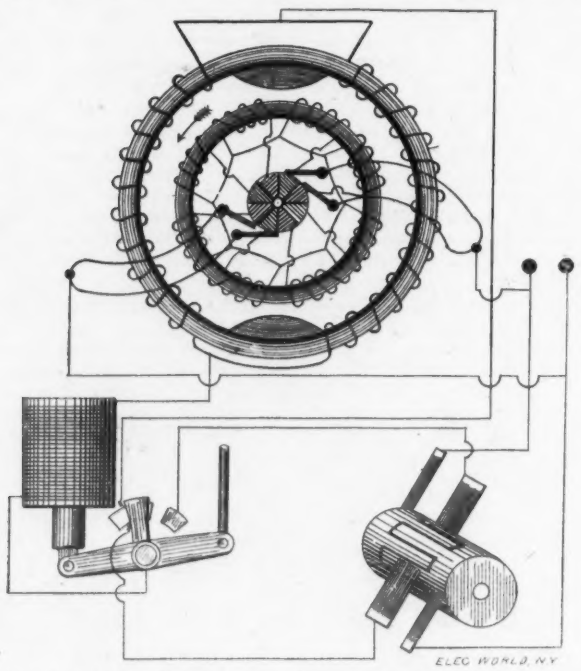
No. 613,090.—Apparatus for Producing Radiation of Electricity.

said vessel made of material—such as refractory oxide or thorium or other refractory oxides or earths—which can be rendered incandescent by currents which are practically available for lighting purposes, substantially as described.

613,116. DYNAMO-ELECTRIC MACHINE OR MOTOR; S. G. Brown, of London, England. App. filed April 9, 1898. A dynamo or motor having a commutating field separate from and at a higher potential than the rest of the magnetic field, substantially as described.

613,128. ELECTRIC SWITCH; William Ely, of Providence, R. I. App. filed Sept. 5, 1896. In an electric switch having a rotatable shaft, contacts carried by said shaft, and a crank or arm secured upon said shaft, combined with said parts, the described means for imparting initial movements to said crank and shaft in one direction only, said means consisting of a lever pivoted at one end, and a pawl pivoted at one end to the pivoted end of said lever and adapted with its free end to releasably engage with the free end of said crank, and other means for completing with accelerated movement the rotation of said crank and shaft.

613,129. ELECTRIC SWITCH; W. Ely, of Providence, and W. B. Bernardini, of Lakewood, R. I. App. filed July 29, 1896. In an electric switch having contact posts arranged in pairs or series, and knives or arms carried by a rotatable shaft for connecting said posts in pairs or series, the combination with said parts of a loose arm, link, cross head, stationary guideway, crank



No. 613,135.—Alternating-Current Electric Motor.

arm rigidly secured to said shaft, extensible spring, and actuating lever loosely pivoted upon said shaft.

613,135. ALTERNATING-CURRENT ELECTRIC MOTOR; A. S. Frazer, of Tynemouth, England. App. filed Dec. 28, 1897. In an alternating electric motor, the combination of a rotor provided with windings connected to a commutator and main circuit conductors supply current to the said rotor, with a stator polarized by induction, a solenoid in circuit with the coils of the said stator, a core or plunger for the said solenoid, the brushes of the said commutator and devices intervening between the said core and the said brushes, whereby the latter are automatically shifted forward on the said commutator by the action of the said solenoid when the speed of the rotor approaches synchronism, substantially as described.

613,140. CIGAR LIGHTER; A. C. Gruhlke, of Waterloo, Ind. App. filed Jan. 19, 1898. In a cigar lighter, the combination, with a body, a lever carried by the said body, and a tongue pivotally connected with the said lever, being limited in its movements in direction of the said body, of a receptacle, a spout for the same, the spout being a conductor of electricity and being provided with a gas chamber above the said spout, and conducting wires connecting with the body and with the said tongue, as described.

613,175. UNDERGROUND ELECTRIC RAILWAY SYSTEM; F. D. Robb, of Hot Springs, Ark. App. filed July 2, 1897. A conduit comprising a sectional casing, hooks and studs on opposite sections for uniting the same, the upper part of one side of the curved body of each section being cut out to form an opening communicating with the interior of the casing, curved hinged doors adapted to close said openings, and means for securing the door in a closed position, substantially as described.

613,177. SAFETY DEVICE FOR SUSPENDED CONDUCTORS; J. N. Thomas, of Johnstown, Pa. App. filed Jan. 20, 1898. The combination of a main feeder in connection with one side of the circuit, a bared conductor, an electromagnetic switch connected to the main feeder and to a central portion of said conductor, and an energizing coil composed of two accumulative windings, one of which is connected to one end of the conductor and the other to the other end of the conductor.

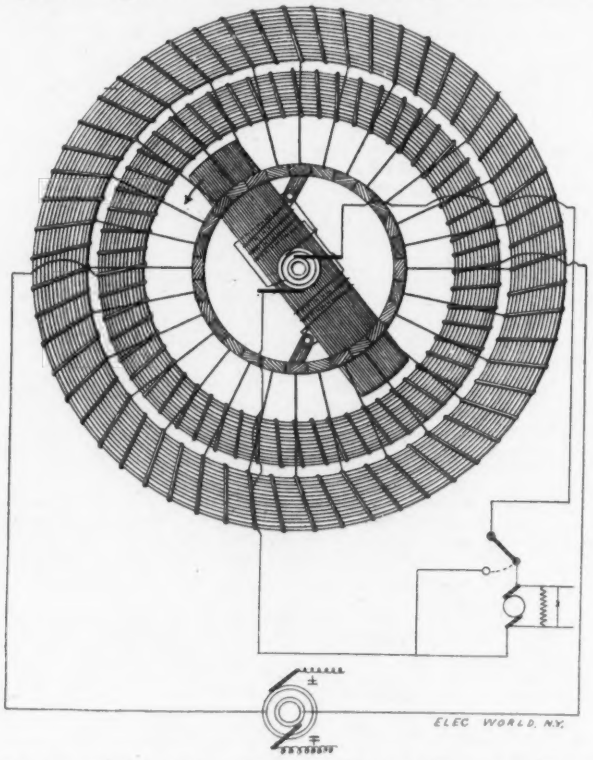
613,181. TROLLEY POLE; J. Walsh, of Elyria, Ohio. App. filed Nov. 2, 1896. The combination with a car of a pivoted trolley pole provided at its upper end with a cross-head having guides, a sliding rod situated within said guides, and a rotatable trolley wheel through which said rod extends.

613,203. ALTERNATING-CURRENT MOTOR SYSTEM AND METHOD OF OPERATING SAME; M. Hutin and M. Leblanc, of Paris, France. App. filed April 10, 1897. The method of starting a single-phase alternating-current motor from rest under load, which consists in supplying multiphase e. m. f. to the circuits of its induced windings from an external source.

613,204. ALTERNATING-CURRENT ASYNCHRONOUS MACHINE; M. Hutin and M. Leblanc, of Paris, France. App. filed May 4, 1897. In an asynchronous dynamo electric machine, the combination with the inducing member of an induced member and a phase-regulating dynamo machine of the direct-current type, having an alternating field of force, connected thereto.

613,205. ELECTRIC-CURRENT LEVELER; M. Hutin and M. Leblanc, of Paris, France. App. filed Dec. 16, 1897. The combination of a magnetic, laminated core, a high resistance metal spool thereon, a winding on the spool and a series of annular iron laminæ surrounding the core to close its magnetic circuit, substantially as described.

613,206. METHOD OF AND MEANS FOR SYNCHRONIZING; M. Hutin and M. Leblanc, of Paris, France. App. filed Dec. 30, 1897. The method of synchronizing two or more alternate current dynamo electric machines,



No. 613,209.—Alternating-Current Dynamo-Electric Machine.

electrically connected together, which consists in varying an extra load on one or more of these machines by and in accordance with any departure from synchronism, substantially as described.

613,209. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE; M. Leblanc, of Paris, France. App. filed April 10, 1897. The method of operating an electric motor, which consists in supplying its field magnet windings with direct current and its armature with alternating current through the same line.